THE LONDON NATURALIST

the journal of the
LONDON NATURAL HISTORY SOCIETY

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The Society welcomes new members, both beginners and experts. Its Area lies within a 20-mile (32 km) radius of St Paul's Cathedral and here most of its activities take place. Although much is covered with bricks and mortar, it is an exciting region with an astonishing variety of flora and fauna. The Society comprises sections whose meetings are open to all members without formality. For those interested in arachnology, archaeology, botany, conchology, conservation, ecology, entomology, geology, herpetology, mammalogy, ornithology or rambling, there is a section ready to help.

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Contents

Report of the Society for 1981*

This has been another quiet year. A number of senior officers of the Society have stood down: Miss M. P. Brown, the Treasurer, J. B. Cresswell, the Secretary, and Mrs. S. Joy, the Secretary of LNCC. We thank them for their services during their respective terms of office.

The programme, as ever, has been full; and our thanks go to all personnel who have arranged, organised and led the various talks and visits. We thank C. W. Plant for organising the 1980 Symposium. It did not prove as popular as earlier ones; perhaps because of the change in venue. For 1981, we have reverted to the Presidential Address, but we will be looking at the possibility of future symposia.

During the year there has been a number of contacts and discussions with other bodies. The most potentially important of these, has been with the nascent London Wildlife Trust. An exhibit was organised for the Institute of Biology's Conversazione, and it will be shown again at the Annual Exhibition of the Botanical Society of the British Isles.

Work on the Plant Atlas continues, as do the monthly visits to Bookham Common.

There has been only a slight drop in the membership figures. The apparent increase in Senior Members is due to their being previously included as Ordinary Members. The figures are as follows:

	1981	*1980*
Ordinary	891	*938*
Affiliated	24	*20*
Family	103	*99*
Junior	29	*34*
Senior	74	*48*
Honorary	16	*14*
Life	9	*11*
Total	1,146	*1,164*

Leslie Baker was elected an Honorary Vice-President in respect of all his sterling work with the Society; and Miss Hilda Franks was elected an Honorary Member.

Only one death has been notified during the year; that of H. A. Littlejohn, who joined the Society in 1926.

As always, we thank Imperial College for allowing us to use their rooms for committee meetings, and Mr. Whitworth and his staff for the custody of the Society's library.

*Presented at the Annual General Meeting, 8 December 1981.

London Nature Conservation Committee Annual Report 1981

The London Nature Conservation Committee met four times in 1981 under the chairmanship of John Montgomery and continued its work of helping to safeguard a wide variety of sites of wildlife interest against detrimental proposals. As forecast in last year's Report, the London Nature Conservation Committee's role has largely been overtaken by the London Wildlife Trust which will be affiliated to the Royal Society for Nature Conservation — the association of Nature Conservation Trusts. An overlap of work has therefore been inevitable and is partly reflected through dual membership of L.N.C.C. and the London Wildlife Group Conservation Committee, and the fact that John Montgomery has been nominated Chairman of the latter. The question of whether the L.N.C.C. will continue to exist from 1982 depends very largely on how quickly the Charity Commissioners give the London Wildlife Trust charitable status, the goodwill of the London Natural History Society and the appointment of a full-time Secretary to carry the administrative burden of running a Conservation Committee. The latter of course has always been the major drawback in operating the L.N.C.C. efficiently. The future co-operation of the London Wildlife Trust on the conservation side, and the London Natural History Society on the natural history side, will ensure greater conservation of sites in London and the establishment of a better network of local contacts among individuals and community groups.

Supporting the Nature Conservation Trusts, the Nature Conservancy Council, local natural history societies and groups, has remained the major proportion of L.N.C.C.'s work together with the referral of information to appropriate agencies and the answering of enquiries. Representation has been maintained on the Colne Valley Committee, the Lee Valley Conservation Group and committees of the Regional Council for Sport and Recreation.

An active watchdog role has been kept on many sites in London and the surrounding area including Hampstead Heath, Chelsea Creek, Frays Meadows, the M25, Mitcham Common, the River Wandle, Crayford Marshes, Redbridge Sewage Works and Walthamstow Reservoirs, to name a few.

The 1981 Castell Memorial Lecture, given by Edward Dawson of the Council for Environmental Conservation on the theme *The Environmental Movement in the 1980s* has been reproduced in a booklet format by CoEnCo with financial assistance from the London Natural History Society.* The 1982 Castell lecture is to be given by Chris Wood of the Avon Wildlife Trust on the work of this organisation — a pioneer Trust in the world of urban nature conservation. The choice of this topic reflects both a growing interest in urban natural history and wildlife, and parallel movements in London to set up an effective body to deal with the issues arising from ever increasing pressure on urban wildlife sites.

*Available from CoEnCo, Zoological Gardens, Regents Park, London NW1 4RY, price 50p, post free.

Mollusc, Ostracod and Plant Remains from Early Postglacial Deposits near Staines

by R. C. PREECE* and J. E. ROBINSON†

Summary

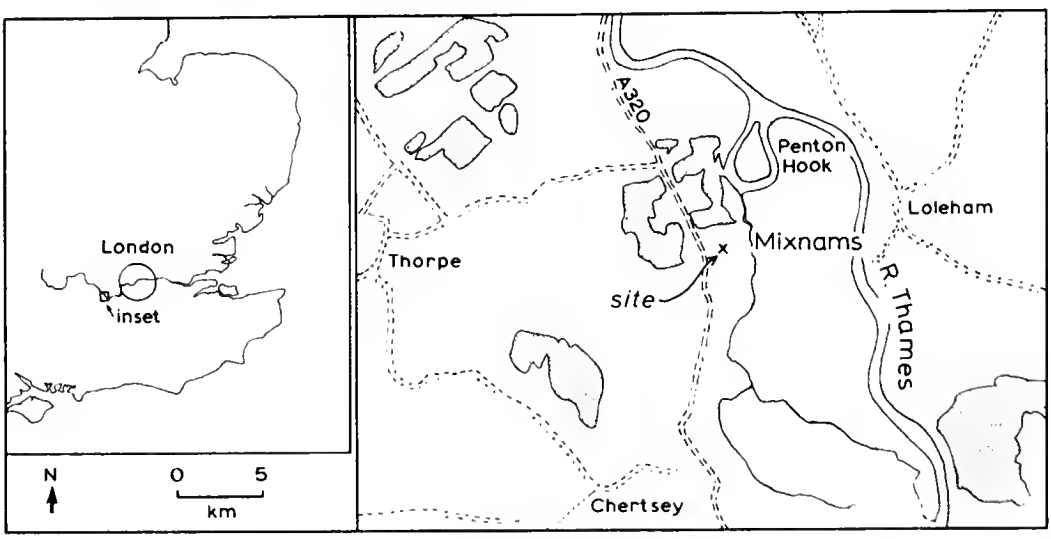
Recent quarrying in a gravel pit near Mixnam's Ferry (TQ 042685) 3 km south of Staines exposed a channel cut into Devensian gravels. The fauna (Mollusca, Ostracoda) and plant remains from the Postglacial organic sands and silts filling this channel are described and compared with other Thames deposits of similar age. Several locally extinct freshwater molluscs were found including *Gyraulus acronicus* and *Myxas glutinosa*. The fossil evidence indicates that the sediments were deposited mainly by a slow, well-vegetated, stream under fully temperate conditions. Two radiocarbon dates of 8360 ± 100 BP (Q-2042) and 6655 ± 55 BP (Q-2043) were obtained from *Salix* wood taken from the base and near the top of the channel respectively.

Introduction and Stratigraphy

Deposits of sand and gravel are widespread in the neighbourhood of Staines, Surrey (Dewey and Bromehead 1915). These are regarded as belonging to the Lower Floodplain Terrace of the Thames and of probable Late Devensian age (Gibbard and Hall 1982). Good sections are visible in commercial workings at several localities.

In February, 1979, a gravel pit near Mixnam's Ferry, Thorpe (TQ 042685), 3 km south of Staines was visited. This pit occupies a plot of land bordered to the east by the River Thames and Penton Hook, to the west by the A320 and by Temple Gardens and Mixnam's Lane to the north and south respectively (Fig. 1.). The ground surface here is at *c.*14m OD. The water level had been lowered by pumping by about 3m, exposing organic deposits filling a channel about 5m wide cut into the gravels.

FIG. 1. Location of site.



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The stratigraphy was as follows (see also Fig. 2):

0 — 70cm	brown silty clay, mottled in places. 0cm = ground surface.
70 — 120	grey, well-sorted, current-bedded sand.
120 — 165	dark grey organic-rich silts with wood fragments, hazel (*Corylus*) nuts, etc.
165 — 205	shelly silty sands with several distinct organic seams up to 3cm thick.
205 — 210	gravel.
210 — 265	shelly silts and sands, some plant debris.
265 — 275	orange gravel and sand.
275 — 285	dark grey organic-rich silts with wood fragments.
285cm+	orange gravel.

Calcareous encrustations were present on many shells and pebbles.

This section was available for study only for a very short time; pumping has ceased and the pit is now flooded.

Mollusca

Ten samples were cut from the face of the section at the depths shown in table 1. Samples for molluscan and ostracod analyses were dried and 0.5kg subsamples were wet sieved. All specimens retained by a B.S. mesh No. 30 (0.5mm) sieve were picked; the results are given in table 1 and plotted graphically in Figure 2.

Mollusca were abundant and generally well preserved, the periostracum being still present on many specimens. In order to simplify the presentation and discussion of these results, the freshwater Mollusca have been grouped into the four ecological categories defined by Sparks (1961). The frequencies of the land Mollusca have been calculated as percentages of the total freshwater Mollusca and plotted as open histograms on the right of Figure 2. The land mollusc data have also been simplified by grouping certain species into the following three ecological categories:

Swamp species (obligatory hygrophiles): *Carychium minimum, Oxyloma pfeifferi, Vertigo antivertigo, Zonitoides nitidus.*

Terrestrial 'A'; catholic species of wide ecological tolerance: *Cochlicopa, Punctum, Vitrea, Nesovitrea, Deroceras/Limax, Euconulus, Cepaea/Arianta*

Terrestrial 'B'; certain common shade-demanding species: *Carychium tridentatum, Aegopinella,* Clausiliidae.

The freshwater fauna is rich (28 species) and indicates a substantial, well-vegetated, sluggish stream. There is little stratigraphical change in the composition of the freshwater Mollusca throughout the section studied. *Theodoxus fluviatilis*, a species characteristic of fast well-oxygenated water, was however only present in the sand overlying the organic silts. Its occurrence here suggests that rather higher energy conditions were responsible for the deposition of the sand.

Several uncommon species were present. *Myxas glutinosa* is a rare calciphile that inhabits clean well-oxygenated ditches and canals, slow rivers and shallow lakes (Boycott 1936). Although fairly widespread in the 19th century, in recent years its occurrence has been confirmed at only two sites in Britain (Lake Bala and Lake Windermere) and in some canals and lakes in the central plain of Ireland (Kerney 1976). There are several old (pre-1950) records from the Thames Valley near Reading and Oxford. Both Kennard and Woodward (1906) and Cooper (1907) record it as fossil from Postglacial sites near Staines. It is also known from the Late-glacial at Nazeing in the Lea Valley (Allison, Godwin and Warren 1952).

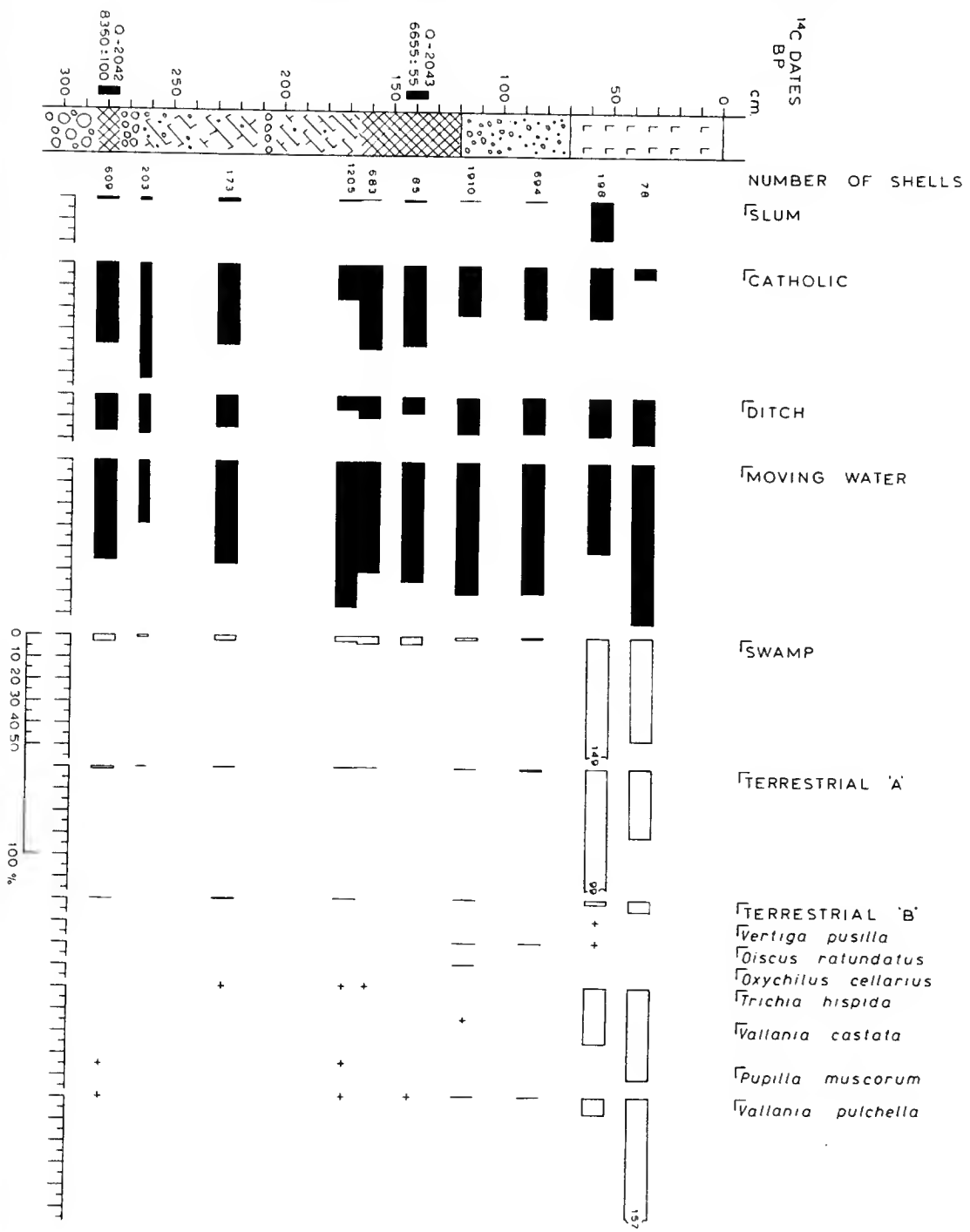
Gyraulus acronicus (Férussac) (=*Planorbis stroemii* of British authors) is frequent in the organic silts. This species was first recorded in Britain by Woodward (1890:339) as a keel-less form of *Planorbis carinatus* Müller, in Postglacial deposits of the Thames at Westminster. A. C. Johannsen later identified these fossils as *Planorbis stroemii* Westerlund, a form now living in Siberia, Finland and northern Scandinavia. Kennard and Woodward (1901:

TABLE 1. Occurrence of Mollusca.

Depth (cm) below surface.	275-285	260-265	220-230	165-175	155-165	135-145	110-120	80-90	50-60	30-40
Theodoxus fluviatilis (L.)	—	—	—	—	—	—	18	7	—	—
Theodoxus opercula	—	—	—	—	—	—	1	—	—	—
Valvata cristata Müller	91	31	21	65	59	5	315	106	8	4
Valvata piscinalis (Müller)	73	17	34	208	74	18	486	189	10	7
Bithynia tentaculata (L.)	95	19	22	352	160	20	469	141	7	6
Bithynia leachii (Sheppard)	44	7	8	159	43	3	121	56	2	1
Bithynia opercula	63	23	45	46	117	18	219	139	20	4
Carychium minimum Müller	3	2	3	5	7	2	13	2	48	3
Carychium tridentatum (Risso)	—	—	1	—	—	—	—	—	—	—
Aplexa hypnorum (L.)	—	—	—	—	1	—	—	—	—	—
Physa fontinalis (L.)	34	6	10	37	36	1	9	—	—	—
Lymnaea truncatula (Müller)	1	2	1	3	3	—	4	—	6	—
Lymnaea stagnalis (L.)	5	—	2	14	11	2	—	—	—	—
Lymnaea peregra (Müller)	54	16	24	87	57	3	83	57	3	—
Myxas glutinosa (Müller)	3	1	2	3	—	—	—	2	—	—
Anisus leucostoma (Millet)	2	—	1	7	—	—	—	—	—	—
Bathyomphalus contortus (L.)	4	6	1	16	1	—	69	19	—	—
Gyraulus albus (Müller)										
G. acronicus (Férussac)	14	1	7	75	50	5	115	27	3	1
Armiger crista (L.)	51	39	10	27	51	13	62	30	2	—
Hippeutis complanatus (L.)	2	1	—	4	41	1	—	—	—	—
Ancylus fluviatilis Müller	14	8	2	7	7	—	23	11	2	—
Acroloxus lacustris (L.)	3	3	1	3	6	—	1	2	1	—
cf *Oxyloma pfeifferi* (Rossmässler)	5	—	1	12	7	1	2	1	6	2
Cochlicopa lubrica (Müller)	2	—	—	3	2	—	4	3	20	5
Vertigo pusilla Müller	—	—	—	—	—	—	—	—	1	—
Vertigo antivertigo (Draparnaud)	4	—	—	1	1	—	—	—	—	—
Pupilla muscorum (L.)	1	—	—	1	—	—	—	—	—	—
Vallonia costata (Müller)	—	—	—	—	—	—	1	—	—	—
Vallonia pulchella (Müller)	1	—	—	1	—	1	2	1	4	10
Vallonia pulchella/excentrica	—	—	—	—	—	—	—	—	—	20
Punctum pygmaeum (Draparnaud)	1	—	—	—	—	—	—	—	1	—
Discus rotundatus (Müller)	—	—	—	—	—	—	2	2	1	—
Vitea crystallina (Müller)	—	—	—	—	—	—	1	1	19	—
Nesovitrea hammonis (Ström)	—	—	—	—	—	—	1	1	6	1
Aegopinella nitidula (Draparnaud)	—	—	—	—	—	—	2	—	1	—
Oxychilus cellarius (Müller)	—	—	—	—	—	—	2	—	—	—
Zonitoides nitidus (Müller)	6	—	—	11	9	—	9	2	22	4
Limacid plates	—	1	—	—	—	—	—	—	3	4
Euconulus fulvus (Müller) agg.	3	—	1	2	—	—	—	—	1	—
Cochlodina laminata (Montagu)	—	—	—	—	—	—	—	—	—	1
Clausilia bidentata (Ström)	1	—	—	1	—	—	—	—	—	—
Trichia hispida. (L.)	—	—	1	1	1	—	—	—	13	8
Arianta arbustorum (L.)	—	—	—	—	—	—	—	1	1	1
Cepaea/Arianta	—	—	—	—	—	—	—	1	1	1
Sphaerium corneum (L.)	11	1	8	9	11	1	1	1	2	—
Sphaerium lacustre (Müller)	—	1	—	—	—	—	—	—	—	—
Pisidium casertanum (Poli)	2	—	1	11	4	2	4	1	5	—
Pisidium obtusale (Lamarck)	6	—	—	—	—	—	—	—	—	—
Pisidium milium Held	25	18	6	12	10	1	24	2	—	—
Pisidium subtruncatum Malm	53	58	8	23	93	4	21	10	—	—
Pisidium henslowanum (Sheppard)	—	—	—	1	—	—	3	1	—	—
Pisidium hibernicum Westerlund	3	2	—	2	2	—	3	—	—	—
Pisidium nitidum Jenyns	80	4	16	133	61	8	132	49	5	—
Pisidium pulchellum Jenyns	—	—	—	4	2	1	—	—	—	—

1906), Cooper (1907; 1922) and Howard (1952) give additional fossil records from Thames alluvium. In the early years of this century *G. acronicus* was discovered living at various localities in the Thames and its tributaries in 'quiet little backwaters where there is a grassy margin and muddy bottom' (Cooper 1924). In Britain it appears to be confined to the Thames basin and seems to be declining, at least in the lower reaches of the river (Kerney 1976). There is considerable doubt

FIG. 2. Relative frequencies of certain ecological groups of Mollusca. Land Mollusca (open histograms) are calculated as percentages of the total freshwater Mollusca.



as to whether this form should be afforded species status or merely be regarded as a hypertrophied form of *Gyraulus albus*. In comparison with *G. albus*, adult shells of *G. acronicus* have a more keeled periphery and less obvious spiral microsculpture (Ellis, 1969: plate IV, figs 7-12). However the separation of immature shells proved impossible, so separate totals are not given.

The occurrence of *Pisidium pulchellum* and *P. hibernicum* is also noteworthy. These species are widespread but local and are generally found in clean water or in running ditches and slow streams, sometimes in lakes but seldom in large rivers (Boycott 1936). There are very few well-dated fossil records of these species from Britain.

The clay (0-70cm) overlying the sand contains a greater frequency of land Mollusca. Many of these species inhabit marshes or waterside vegetation. Deposition of this fine-grained alluvium would thus appear to represent overbank sedimentation.

The presence of *Vertigo pusilla* and *Cochlodina laminata* deserves special comment. The former was widespread during the early Postglacial but in Britain today it is virtually confined to rupestral habitats such as old stone walls. *C. laminata* is also a shade-demanding species, still quite frequent in southern Britain generally although rare in the Staines area.

Ostracoda

A duplicate series of samples (0.5kg dry weight) from the identical levels analysed for Mollusca was processed down to a 120 mesh (0.125mm). The results are presented in table 2.

TABLE 2. Staines, Ostracoda.

Depth (cm)	275-285	260-265	220-230	165-175	155-165	135-145	110-120	80-90	50-60
Candona candida (O. F. Müller)	42	35	27	29	35	68	3	3	6
Candona neglecta Sars	69	61	26	27	32	40	1	—	8
Candona compressa (Koch)	9	—	—	—	—	—	—	—	—
Candona pratensis Hartwig	—	45	10	16	16	33	2	—	—
Candona fabaeformis (Fisher)	3	11	1	5	8	—	—	—	—
Cyclocypris laevis (O. F. Müller)	—	1	—	1	4	—	1	—	—
Notodromas monacha (O. F. Müller)	—	—	1	—	—	—	—	—	—
Eucypris pigra (Fischer)	24	27	—	6	15	15	—	—	1
Eucypris heinrichi Diebel & Pietrzeniuk	—	—	—	—	1	—	—	—	—
Herpetocypris reptans (Baird)	6	4	—	—	—	—	—	—	—
Ilyodromus olivaceus (Brady & Norman)	6	6	2	—	—	—	—	—	—
Cypridopsis vidua (O. F. Müller)	3	3	4	—	2	—	—	—	—
Potamocypris wolfi Brehm	—	3	—	—	—	—	—	—	—
Darwinula stevensoni (Brady & Robertson)	15	25	23	9	14	8	—	—	—
Paralimnocythere compressa (Brady & Norman)	—	4	—	—	—	—	—	—	—

Totals refer to the number of individual valves

A trial sample from 260-265cm yielded the following additional species not present in the sample finally counted: *Candonopsis kingsleyi* (Brady and Robertson), *Candona fragilis* Hartwig, and *Potamocypris fulva* (Brady).

The fauna as a whole indicates a shallow sluggish stream, with both active-swimming (e.g. *Cypridopsis vidua*, *Potamocypris* spp.) and bottom-dwelling (e.g. *Candona* spp.) represented. Most species present can be found today in small water bodies with abundant aquatic vegetation, often with muddy bottoms. The presence of *Darwinula stevensoni*, *Candona pratensis* and *C. fabaeformis* suggests bank-margin settings or prevailing depths of water not exceeding 2m.

Ostracods were most frequent in the basal samples suggesting quiet conditions with a rich diversity of micro-habitats. The decline in species diversity higher in the profile, together with the continuing dominance of *Candona neglecta* and *C. candida*, suggest shallowing coupled with possible vegetation overgrowth, both effectively eliminating the open-water conditions required by the active swimming species. As expected, the sand unit contained relatively few ostracods; sands are generally inhospitable on account of sediment mobility, as well as having low food potential for typically scavenging ostracod populations.

The presence of both *Eucypris pigra* and *Ilyodromus olivaceus* in the basal samples, may represent valves washed into the area from nearby springs or water-meadows. Both are species which dominate the faunas of calcareous tufas (Kerney, Preece and Turner 1980) but at Staines they represent only a relatively minor element in a much more diverse fauna.

The absence of *Cytherissa lacustris, Limnocythere* spp. *Cypria ophthalmica, Scottia* and the scarcity of *Herpetocypris* spp, rule out lake or large pond environments. The absence of large, active swimming faunas such as *Prionocypris* spp. suggests slow flowing conditions.

The presence of *Paralimnocythere compressa* is noteworthy because it is said to be restricted to cold climates 'accompanied by abundant aquatic plants typical of muddy substrates, and shallow rather still bodies of water' (De Deckker, 1979). This small species has been recorded from cool spring deposits at Süssenborn near Weimar in Saxony (Diebel and Pietrzeniuk 1969) and at Tiraspol in Moldavia (Negadaev-Nikonov 1971) both of early Middle Pleistocene age. In Britain it is known from West Runton, Norfolk in the cold climate Beestonian 'B' zone (De Deckker 1979: 295-296). The species still survives in Europe.

Notodromas monacha can swim (using the surface tension effect at the water surface), upside down using a flattened ventral surface and its presence also suggests rather quiet conditions. According to Absolon (1973) this species is widespread today but was not common during the early postglacial.

Palaeobotany

Several samples were prepared for pollen analyses by Dr. K. Alvin but the pollen was too poorly preserved for counting.

TABLE 3. Plant macrofossils.

Depth:	*275-285cm*	*135-145cm*
Radiocarbon dates (a.BP)	8360±100	6655±55
Trees:		
Quercus sp	1 fruit	1 fruit
Shrubs:		
Prunus spinosa L.	—	1 fruit-stone
Salix sp.	wood-fragments	1 leaf-fragment; wood-fragments
Terrestrial herbs:		
cf. *Bidens* sp.		1 achene
Ranunculus sp.	—	1 achene
Aquatic:		
Nuphar lutea (L.) Sm.	—	10 seeds
Potamogeton cf. *perfoliatus* L.	—	4 fruit-stones
Mosses (leafy stems):		
Eurhynchium sp.	1 (6mm, g)	1 (6mm, g)
Homalothecium cf. lutescens (Hedw.) Robins	—	1 (11mm vg)
Homalothecium sp.	—	1 (5mm, g)
Neckera complanata (Hedw) Hüb.	—	5 (12mm, vg)
cf. *Orthotrichum* sp.	—	3 (12mm, b)
Thamnobryum alopecurum (Hedw.) Nieuwl.	—	2 (13mm, b)

Residues of two dried samples of silt from which Mollusca had been extracted were analysed for plant macrofossils by Dr. D. T. Holyoak (Department of Geography, Reading). These samples were from the same levels as the wood of *Salix* which was radiocarbon dated.

The fossil angiosperm material was mostly in a corroded condition so that less resistant parts may have been lost from the deposits. However, some of the moss stems were well preserved; their length and condition are listed above following the conventions used by Dickson (1973).

The few species recorded severely limit the inferences that can be made regarding the plant associations from which the material was derived. *Nuphar lutea* and *Potamogeton perfoliatus* prefer water of at least 0.5m depth that is not very rapidly flowing and usually with muddy substrates. The other material was washed in, probably both from deciduous woodland and more open plant associations. Amongst the mosses, *Thamnobryum alopecurum* and *Neckera complanata* both prefer shaded sites and typically occur in woodland; *N. complanata* is a calciphile (Watson 1968). However *Homalothecium* spp. and *Ranunculus* spp. do not tolerate deep shade and *Prunus spinosa* typically forms scrub on good soils where it is not heavily shaded by trees.

Radiocarbon Dates

Two samples of wood (*Salix* sp., det. K. L. Alvin), one from the organic silts at the base of the channel (275-285cm) and the other from near the top of these silts (135-145cm), were radiocarbon dated at the Godwin Laboratory, Cambridge, with the following results:

135 — 145cm	Q-2043	6655±55 BP
275 — 285cm	Q-2042	8360±100 BP

Conclusions and Discussion

Detailed investigations of the fossiliferous silts and sands suggest that they represent a channel-fill that accumulated mainly under shallow slow-flowing water conditions in a fully temperate climate. The base of the channel is fairly sharp, but it is not clear whether it was cut by the same stream that deposited these early Postglacial silts. The basal sediments fine upwards into the dark grey organic-rich silt. At least five prominent irregular seams of inwashed plant debris each about 3cm thick occur in the silts below 165cm, suggesting periodic flooding.

A substantial increase in discharge is indicated by the current-bedded coarse sand that has eroded the top of the silts. *Theodoxus fluviatilis* occurs only in this bed.

Above the sand is a bed of clay rich in swamp and riverside Mollusca. This is thought to represent overbank deposition.

The two radiocarbon dates of 8360±100 BP and 6655±55 BP were obtained from the base of the channel and from near the top of the organic silts respectively. They confirm that the faunas belong to the early Postglacial and provide some evidence of the rate of channel aggradation, although one should always be cautious when using radiocarbon dates from fluvial sediments, because of the dangers of re-working.

Several other fossiliferous Postglacial alluvial deposits have been reported near Staines and Chertsey. Kennard and Woodward (1906) describe the Mollusca from a section 'on the left bank of the Thames fully a mile west of Staines on the tow-path towards Old Windsor'. Cooper (1907) listed a similar molluscan fauna from a deposit 'close to Staines Gasworks' and also from a section 'at the middle of the U-shaped bend of the Thames at Penton Hook, in the Middlesex bank' (Cooper 1922).

More recently, Howard (1952) described sections in Otterway's gravel pit, Staines Lane, Chertsey, (TQ 040691). At least three different channels cutting into Devensian gravels were visible here in 1950. The largest was '77 feet (23.3m) wide and about 6 feet (1.8m) deep with a filling of light grey silt containing numerous *P. acronicus*. Near the base were bones and Iron Age sherds and below these at one spot a deposit of peat, containing *Aplexa hypnorum* (L.) and *Segmentina nitida* (Müller) which were not found elsewhere on the site'. A smaller channel (*c.* 50 feet wide) of later date had cut through these grey silts and had been filled with 'a darker clay deposit from which *P. acronicus* was absent'. (Howard 1952: 262).

The molluscan faunas described by all these authors are broadly similar to the one described here.

The living molluscan fauna of this stretch of the River Thames differs significantly from these fossil assemblages. *Gyraulus acronicus* has not been found living recently in this vicinity and furthermore it is possible that some, at least, of the old records refer to fossils derived from these deposits. The earliest known occurrence of *G. acronicus* in the Thames system is from the Hoxnian interglacial deposits at Swanscombe, Kent (Kerney 1971). In the Postglacial, it survived in the lower reaches of the Thames at least until the Tudor period. It was frequent in Roman alluvium at Tooley Street (Kennard and Woodward 1906), in late mediaeval alluvium at Blackfriars (Berry 1978) and in sediment of late mediaeval to Tudor age from Abingdon Street, Westminster (Preece 1979). At the last two sites it was associated with *Pseudamnicola confusa* (Frauenfeld), an uncommon prosobranch requiring slightly brackish water, which has also apparently vanished from the lower Thames (Kerney 1976).

It is noteworthy that *Viviparus viviparus* (L.) which is one of the most obvious species inhabiting the Thames today, is absent from all the deposits described by Kennard and Woodward (1906), Howard (1952) and the present authors. It is recorded in the Thames valley only from alluvium of much later date.

It follows that *Gyraulus acronicus* is rarely associated with *Viviparus viviparus* in these Thames deposits. However they were both listed from a sandy deposit in the Lockwood reservoir near Walthamstow which was said to be quite modern (Kennard and Woodward 1903). Kennard and Woodward explained this association by suggesting that the *G. acronicus* have been derived from older beds, where the species occurred abundantly. They also state that *G. albus* is commonest in the younger sediments.

Hayward (1956) examined Late Pleistocene and Postglacial channel deposits in the Lea Valley. He gives extensive lists of the contained Mollusca, which he used for local dating, and for correlating these deposits with those of the Thames valley. He regarded the occurrence of *Bithynia leachii* and *Gyraulus acronicus* as important and suggested that they entered the Lea Valley during the 'Romano-British Iron Age'. His dating evidence is however insecure and relies almost exclusively on associated archaeological material, when present. It is now known that both these species occurred at Staines at least as early as 8360±100 BP and in the light of this one must question Hayward's chronology in the absence of supporting radiocarbon dates. Despite these reservations, it is significant that he also records *Viviparus viviparus* from only what he regarded to be the most recent sediments in the Lea Valley. It is hoped that further work in the Thames basin may succeed in establishing a firm regional biostratigraphy for the Postglacial based on freshwater Mollusca, comparable to that already partially achieved using terrestrial faunas (Kerney, Preece and Turner 1980).

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Book Review

The London Region: an Annotated Geographical Bibliography. By Philippa Dolphin, Eric Grant & Edward Lewis. 379 pp., 2 map figs. Marshall Publishing. London. 1981. £30.

Bibliographies are always useful in that they set the researcher on the right path by providing him with the basic references to his chosen topic. Geography has had fewer bibliographies than many other subjects so perhaps it is timely that the authors should bring out theirs on London now. Indeed in another few years their task would be much more difficult, for already the discipline has ramified enormously in the last decade or so and is likely to expand even more in the future. Gone are the days when geography concerned itself with just 'places, inhabitants, and commodities'. In consequence, in addition to students, teachers and librarians, the authors (two from the staff of Middlesex Polytechnic's Geography and Planning Department and the third a librarian with responsibility at the Polytechnic of North London for its geography collection) had a much wider range of potential users in mind for their bibliography, including sociologists, economists, transport officers and local planners.

After commencing with two sections on general works *The London Region* contains a further seven sections of references under the following headings: physical environment; historical patterns of growth and development; economic structure and patterns; transport social patterns and processes; planning the metropolis and beyond; and environmental problems. Of these only the first two and the last sections contain references likely to be of relevance to L.N.H.S. members; the aspects of geology, weather, ecology and archaeology seem to have been well covered. The authors have obviously recognized the value of *The London Naturalist* as a source of important papers for out of the 46 titles listed in their ecology section 16 have been culled from our Society's journal! The sub-section 'Local Topography', arranged by G.L.C. boroughs, faired less well with only 4-6 entries (sometimes less) under each. The authors however are conscious of such shortcomings for in their introduction they state that much, in the end, had to be left out in order to keep the book within bounds. All references have some descriptive matter as to contents so that users can readily select titles likely to be of value to their research. The book is rounded off with an appendix giving a list of libraries in London that have collections devoted to the region, together with a useful subject index to the whole bibliography.

At £30 few L.N.H.S. members will rush to buy themselves a copy, but it is certainly a bibliography that ought to be available in all local Reference libraries in the London area.

ERIC W. GROVES

The Flora of Southern Epping Forest Part 3: Leyton Flats and Bush Wood North†

by P. R. Ferris*

Summary

A survey of the flora of Leyton Flats and Bush Wood North in southern Epping Forest was undertaken during 1980 and 1981. A total of 245 species of vascular plants was found during this period. The survey area and its various habitats are described and the species listed. This is the third paper in a series of four on the vegetation of southern Epping Forest.

Introduction

Leyton Flats and the nearby area to the south-east known as Bush Wood North comprise the third part of the survey of the flora of southern Epping Forest initiated by the Wren Conservation Group (Ferris 1980; 1981). Records were gathered from these areas mainly during 1980 and 1981. The majority of Leyton Flats lies within the London Borough of Waltham Forest, and Bush Wood North is partly in that borough and partly in Redbridge. A map of the study area is presented in Figure 1.

The text follows a similar pattern to that of Part 2 of this flora (Ferris 1981), looking at the area as a whole and then at the different environments and the plants within them. Because of the overall similarity between Leyton Flats and Wanstead Flats to the south-east, some comparison is made between these two areas in the text and further comparisons may be made by referring to Part 2.

Although Bush Wood North might be considered as an extension of Bush Wood proper (or 'South'), which was included in Part 2, it has as much in common with Leyton Flats and is included here for the sake of continuity.

Leyton Flats

Leyton Flats is, like the somewhat similar Wanstead Flats, an open area in the southern reaches of Epping Forest, close to, and almost surrounded by, heavily populated residential areas.

The borders of Leyton Flats proper for the purpose of this survey are the Whipps Cross (North Circular) Road to the south-west, Lea Bridge Road in the west, Snaresbrook Road in the north and the roads known as Hollybush Hill and Highstone to the east. The private grounds of Snaresbrook Crown Court in the north-east corner have not been examined, nor have the south and east banks of the Eagle Pond, which are part of this land. More Forest land in the neighbourhood of Whipps Cross Hospital is separated from Leyton Flats by Whipps Cross Road, and is included in this survey, as is a small portion to the east of the railway cutting near to the Green Man roundabout.

Leyton Flats proper comprises about 75 hectares of land, of which 38 hectares is flat open grassland, 20 hectares woodland and the rest mainly ponds or wet areas. The whole lies on the Boyn Hill Terrace of pebble gravel and alluvium, for which past workings have produced the pits and spoil heaps to be found in parts of the area. The habitats thus formed account at least in part for a flora that differs to some degree from that of the superficially similar environments of Wanstead Flats, with which some interesting comparisons may be made. The same cattle graze on Leyton Flats as on Wanstead Flats, though it seems that they have a

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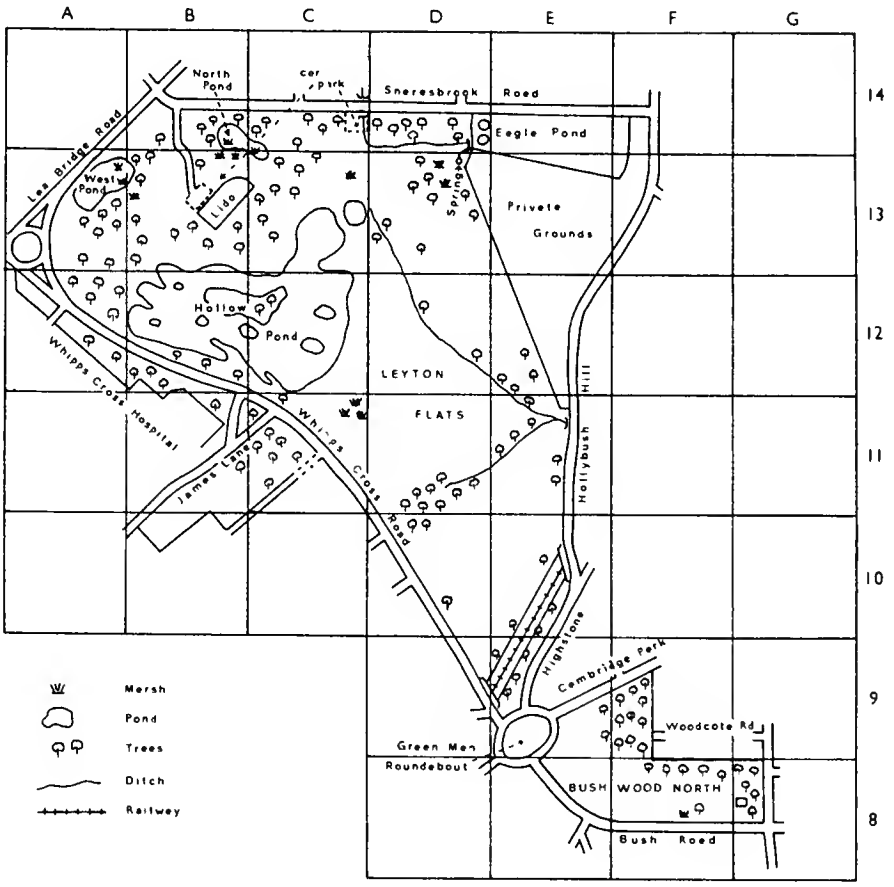
preference for the latter which might be related to differences in the vegetation of the two areas.

Poor drainage of rain-water from Leyton Flats gives rise to considerable waterlogging of the grassland, particularly during winter. There are a number of drainage ditches across the area, of which some drain to the Hollow Pond or the Eagle Pond. Numerous other ponds or damp hollows are mostly the result of past gravel diggings and are scattered mainly around the north and west edges. They have a variety of shapes and sizes, and their transition through a phase of *Sphagnum* bog development is mentioned in the *Flora of Essex* (Jermyn 1975). Of these, only that at the west edge of the Flats by Lea Bridge Road normally has a covering of water for any length of time. At the north edge of the large Hollow Pond is a much smaller expanse of water which drains into its larger neighbour, and it is thought that the water-level here is maintained by a spring. Apart from some kiosks and boat-houses by the Hollow Pond, the only building on the Flats lies just to the north of that pond and is an open-air swimming pool surrounded by railings.

Particularly in the north and west parts of the Flats and mainly around the edge are areas of woodland; there is a scattering of trees elsewhere. There are no deliberately planted groups of diverse species of trees as are to be found on Wanstead Flats, nor roadside lines or avenues. There is in the south-east part of the area a quite extensive patch of mixed gorse and broom scrub, and another area predominantly of gorse north-east of the Hollow Pond.

There are no close-mown playing-fields as on Wanstead Flats, the only mown

FIG 1. Leyton Flats and Bush Wood North, 1981.



grass being by Whipps Cross Road and used as a picnic or recreation area. The overall 'roughness' of the whole area as compared to Wanstead Flats with its large areas of playing-fields seems to put a different emphasis on the recreation and sporting activities which are undertaken. There is virtually no football, cricket or golf practice, nor model aircraft or boats, but there is more unrestricted horse-riding by sometimes large groups of riders, and the hilly banks of the Hollow Pond are used by numbers of motor and pedal-cycle riders as a sort of scramble course. This activity has been seen to have increased recently by Alexandra Lake on Wanstead Flats too, and contributes to the sparsity of plant growth around these lakes. For these reasons, and as little deliberate seeding or planting takes place, nor apparently much casual dumping of garden refuse, Leyton Flats presents a somewhat wilder appearance than does Wanstead Flats.

The grassland

The major expanse of grassland lies to the east and south-east of the Hollow Pond and, apart from a small wooded area near Whipps Cross Road, has trees mainly around the edges, with a scattering elsewhere. Scrub, mainly of gorse *Ulex europaeus* and broom *Sarothamnus scoparius*, occurs in patches. One large area near Hollybush Hill is a mixture of these species, and another by the Hollow Pond consists mainly of gorse. This scrub gives protection to a number of oak seedlings.

Particularly in the south-east part of the Flats, such grasses as perennial rye-grass *Lolium perenne*, cocksfoot *Dactylis glomerata* and Yorkshire fog *Holcus lanatus* are abundant, together with some crested dog's-tail *Cynosurus cristatus*. Common mouse-ear *Cerastium holosteiodes*, white clover *Trifolium repens* and yarrow *Archillea millefolium* are typical common plants to be found amongst these grasses.

North of this, in the central part of the Flats, are extensive areas of mat-grass *Nardus stricta*, as well as brown bent *Agrostis canina* subsp. *montana*, common bent *A. tenuis* and wavy hair-grass *Deschampsia flexuosa*. Amongst these, sheep's sorrel *Rumex acetosella* is common and heath rush *Juncus squarrosus* is widely scattered. One patch of heather *Calluna vulgaris* occurs in the north-east portion. Further north still, the grassland merges into mixed birch and oak woodland, together with some damp hollows in the vicinity of the Eagle Pond.

Within the wooded area that stretches along much of Snaresbrook Road are some small areas of grassland which retain a plant community that suggests a possible relic heathland flora. Such species as tormentil *Potentilla erecta*, heath bedstraw *Galium saxatile* and many-headed woodrush *Luzula multiflora* grow amongst mat-grass and brown bent. In slightly damper conditions in these locations are also to be found common sedge *Carex nigra*, a small amount of carnation-grass *C. panicea*, some patches of creeping willow *Salix repens* and heath grass *Sieglingia decumbens*. This interesting flora is in some danger of being encroached upon by birch scrub.

The woodland and trees

English oak *Quercus robur* and silver birch *Betula pendula* are the dominant tree species on Leyton Flats, together with holly *Ilex aquifolium* and hawthorn *Crataegus monogyna*.

A mixed birch and oak woodland extends across the northern edge of the area, with oak becoming more predominant at the west end of the Flats. A somewhat isolated wood by Whipps Cross Road further south comprises mainly English oak, but has some specimens of Turkey oak *Quercus cerris*. Elsewhere, trees are to found mainly around the edges of the open grassland, while a few, mainly oaks, grow by the sides of the drainage ditches.

Within the oak/birch woodland of the north-east corner there is a group of aspen *Populus tremula*, and a single seedling yew *Taxus baccata*, a species not

otherwise known on Leyton Flats. Although some of the older birch here is dying, as on Wanstead Flats, there are mature trees and an abundance of saplings. Rowan *Sorbus aucuparia* occurs here as saplings only. It may be noted that this species, in sapling form, has increased over the whole southern Epping Forest study area in the last year or two. The reason for this is not known, but it is thought that an increase in local street and garden planting of this species has given rise to bird-sown seedlings. No mature rowan trees are known in this part of the forest. In places the wood is quite dense, with holly, bramble *Rubus fruticosus* agg., and bracken *Pteridium aquilinum*. Both field rose *Rosa arvensis* and dog rose *R. canina* occur.

In the wet areas, particularly in the north and west of Leyton Flats, willow is common and sometimes abundant. Both great sallow *S. caprea* and common sallow *S. cinerea* subsp. *atrocinerea* occur, but more work needs to be done on the identification and distribution of *Salix* spp.

Between the lido and the Hollow Pond, oaks are virtually the only plants to grow on the compacted sandy gravel that occurs here. Within the railings on the west side of the lido there is a large common lime *Tilia×europaea* and a hybrid black poplar *Populus×canadensis* var. *marilandica*, as well as Japanese privet *Ligustrum ovalifolium*.

By Whipps Cross Road and between this road and the Hollow Pond, holly is abundant and there are numerous specimens of wild cherry *Prunus avium*, some elder *Sambucus nigra*, and a single small Turkey oak. Further south the trees thin out as the grassland is met, and a specimen of laburnum *Laburnum anagyroides* is found. By Hollybush Hill both apple *Malus* sp. and pear *Pyrus communis* seem evidence of deliberate planting.

Although the total number of tree species to be found on Leyton Flats is similar to that of Wanstead Flats, and the majority of the species are the same in both areas, the distribution differs considerably. Leyton Flats is dominated by large numbers of few species to an extent that Wanstead Flats with its deliberately planted groups of diverse species is not.

The ponds and wet areas

The Hollow Pond is the largest area of permanent water on Leyton Flats. Muddy regions occur in places by the winding banks of sandy gravel, although the compacted soil away from the water is largely devoid of plant growth. Great reed-grass *Glyceria maxima* and soft rush *Juncus effusus*, with great reedmace *Typha latifolia* and yellow flag-iris *Iris pseudacorus* are typical plants to be found in these muddy waterside areas, as well as spike-rush *Elocharis palustris*, duckweed *Lemna minor* and marsh pennywort *Hydrocotyle vulgaris* in places. In the water common plants are hornwort *Ceratophyllum demersum* and Canadian pondweed *Elodea canadensis*, while spiked water-milfoil *Myriophyllum spicatum*, curly water-thyme *Lagarosiphon major*, grassy pondweed *Potamogeton obtusifolius* and hair-like pondweed *P. trichoides* have all been found. Willow *Salix* sp. is present but not in quantity, around the edge. The numerous islands of the lake have not been investigated, but it can be readily seen that those particularly at the east end have much gorse cover, and silver birch is common.

Over-flow water runs into the Hollow Pond from a much smaller pond at its north-east corner. There are some patches of low plant growth around its banks, including toad rush *Jancus bufonius*, jointed rush *J. articulatus*, and of particular interest, near its north bank, slender rush *J. tenuis*. Canadian pondweed is also present in this pond, as are lesser pondweed *P. pusillus* and hair-like pondweed.

The second largest of the permanent open waters is the Eagle Pond, less natural looking than the others, partially due to the pavement of Snaresbrook Road which forms its northern perimeter. The east end and the south side of this pond, although forming the boundary of the study area, have not been investigated as

they are in private grounds. Only the short length of the pond's western end adjoins the woodland area of Leyton Flats. At the water's edge grow pale persicaria *Polygonum lapathifolium*, water-pepper *P. hydropiper*, trifid bur-marigold *Bidens tripartita* and a specimen of white willow *Salix alba*. Also present are some hard rush *Juncus inflexus* and the only specimen of remote sedge *Carex remota* known on Leyton Flats. Nearby there is a spring with a stone edge, which flows by way of a stream into the Eagle Pond. This spring is about a metre across and contains much floating sweet-grass *Glyceria fluitans*.

The third pond in size and which usually has some water-cover is that at the west end of the Flats by Lea Bridge Road. This is closely surrounded by trees except on the side by the road, and willows are abundant particularly at the north-east end. Also at this end great water-grass grows luxuriantly and covers a wide area. Marsh pennywort is common here and in many of the damp hollows in this part of the Flats. Water starwort *Callitriche platycarpa* is to be found on the mud at the edge of the pond, as is one patch of bog stitchwort *Stellaria alsine* and some marsh foxtail *Alopecurus geniculatus*.

The area of the North Pond, by Snaresbrook Road, is dominated by *Salix*, with an abundance of soft rush and great water-grass as well as bulbous rush *Juncus bulbosus*, floating scirpus *Eleogiton fluitans* and velvet bent *Agrostis canina* subsp. *canina*.

Numerous other damp hollows, ditches and areas liable to flooding exist on the Flats, and various combinations or representatives of the species mentioned are found in them, as well as others that are presented in the species list.

Other plants and environments

Certain plant species persist on Leyton Flats in more restricted environments than those discussed above, either within or adjacent to the other areas. A notable example of this, perhaps, is buckshorn plantain *Plantago coronopus* which grows in a number of locations on areas of compacted gravel. Such soil exists on the track that lies adjacent to and along much of the length of Whipps Cross Road, on and beside some footpaths, and car parking areas. On the car park to the west of the lido procumbent pearlwort *Sagina procumbens* and sand spurrey *Spergularia rubra* are found. On a bank which separates the grassland from the track by Whipps Cross Road, one plant of columbine *Aquilegia vulgaris* is present, together with such plants as ribwort plantain *Plantago lanceolata*, Oxford ragwort *Senecio squalidus* and groundsel *S. vulgaris*.

A steep bank leads down to the cutting of the Central Line railway, from the drier grassland above to damp and muddy conditions below. Coltsfoot *Tussilago farfara* is abundant on the slope at the south end, and here too is some broadleaved pea *Lathyrus latifolius*. Along the bottom of the slope where a wire fence divides the Flats from the railway, some plants of common horsetail *Equisetum arvense* occur, and there are many specimens of willow, as well as hawthorn, bramble and, actually on railway property which has not otherwise been investigated, silver birch.

Adjacent areas

Separated from Leyton Flats proper by Whipps Cross Road is another area of Forest land mostly beside and just to the south-east of Whipps Cross Hospital. Much of this land is wooded, with some clearings. Especially in the south, English oak is the dominant tree, with holly and hawthorn being abundant. Slightly further north, between the hospital and the road, there are a number of specimens of grey poplar *Populus canescens*, with much regeneration in progress. One locust tree *Robinia pseudoacacia* occurs by the hospital fence, and this almost certainly originated from trees within the hospital grounds. Cut-leaved cranesbill *Geranium dissectum* occurs and goatsbeard *Tragopogan pratensis* is quite common in

the roadside grassland. Just north of the hospital and near to the roundabout is an open area of perhaps somewhat unattractive-looking land, predominantly of grasses and common associated plants such as dandelion *Taraxacum officinale* agg. and catsear *Hypochoeris radicata*. This area was wooded until 1979 when it was cleared to provide safe travel at night for female nursing staff passing between the hospital and nearby bus stops. Similar clearance of roadside vegetation has been undertaken elsewhere in the vicinity of the hospital and in other parts of the study area, such as in Bush Wood (South) by Blake Hall Road early in 1981. This obviously has a disturbing effect on the plant life, but on land to the north of the hospital, where a slight dip occurs in the middle of the area and drainage is poor, as well as soft rush and toad rush the less common slender rush *Juncus tenuis* and hairy sedge *Carex hirta* occur in the habitat created by clearance.

The small area of Forest land separated from the rest of Leyton Flats by the railway cutting and situated between the cutting, the Green Man roundabout complex, and the road called Highstone, comprises an area of trees which are by the railway and an area of grass by the roads. The trees here are of more diverse species in a small area than on the rest of Leyton Flats, and include beech *Fagus sylvatica* and hornbeam *Carpinus betulus*. Lime *Tilia×europaea* is planted by the roadside. The grass area includes common mouse-ear *Cerastium holosteoides* and black horehound *Ballota nigra* as well as spotted medick *Medicago arabica* which has not been found elsewhere. A pile of building rubble and earth which had been tipped onto the grassland harboured at least twenty species of plants, including creeping cinquefoil *Potentilla reptans*, petty spurge *Euphorbia peplus*, wood forgetmenot *Myosotis sylvatica* and germander speedwell *Veronica chamaedrys*.

Species known to have been recorded in recent years from the Leyton Flats area include nine that are specifically mentioned in the *Flora of Essex* (Jermyn 1975), which have all been refound. The earlier *Flora of Essex* (Gibson 1862) includes 58 species from such areas as 'Whipps Cross' and 'Snaresbrook', of which only 23 are known to be still present. The 35 species not found during the present survey are listed in Table 2.

Bush Wood North

To the south-east, and separated from Leyton Flats by the Green Man roundabout, is Bush Wood North. This is on the other side of Bush Road from Bush Wood (South) which was discussed in Part 2. It comprises about 7.5 hectares, much of it open grassland, but with spaced trees lining the roads and a more wooded area which stretches from the east end by Blake Hall Road along the house walls which form the boundary north and east until the road called Cambridge Park is met. This road forms the north boundary as far as the Green Man roundabout. Near the east end is an Epping Forest Keeper's lodge.

Common lime is planted by Cambridge park roadside, and also forms something of an avenue by the footpath which leads westwards as a continuation of Woodcote Road. By Bush Road, London plane *Platanus×hybrida* is planted, and English oak is also present. At the east end of the wood, grey poplar is plentiful and regenerating, with a thick shrub layer which includes hawthorn, holly and elder, all of which are plentiful here and elsewhere in the wooded area. Particularly at the corner of the south and east house-walls, a variety of specimens of trees is present, including beech, red oak *Quercus borealis* and a large horse-chestnut *Aesculus hippocastanum* with a number of saplings. In various other locations field maple *Acer campestre*, rowan, silver birch and ash *Fraxinus excelsior*, as well as the ubiquitous sycamore *Acer pseudoplatanus*, are all present more as saplings than mature trees. A sucker from a garden forsythia *F.×intermedia* also intrudes into the Forest, and there is a laburnum *L. anagyroides* in the wood near Cambridge Park. Also in this locality, stone parsely *Sison amomum* is found, and one or two plants of nettle-leaved bellflower

Campanula trachelium. Peach-leaved bellflower *C. persicifolia* occurs near the keeper's lodge, but is certainly a garden escape or deliberate introduction.

Mostly within the wooded area, and particularly near to the house fences and walls, species such as lesser celandine *Ranunculus ficaria*, dog violet *Viola riviniana*, herb robert *Geranium robertianum* (including a white-flowered form) and ivy-leaved toadflax *Cymbalaria muralis* are present. A variety of species that have presumably been deliberately introduced or outcast from gardens occur. Only those that appear to be established have been included here, and some might prove not to persist. They include Welsh poppy *Meconopsis cambrica*, upright yellow-sorrel *Oxalis europaea*, hyacinth *Hyacinthus orientalis* and *Chionodoxa sardensis* and *C. luciliae*.

Although the wooded part of Bush Wood North has produced a variety of species not or rarely found on the rest of Leyton Flats, the large grassland area is mostly similar to that of particularly the south-east corner of Leyton Flats. The two areas have many species in common, but some of those present in Bush Wood North should be mentioned. The grasses include some sheep's fescue *Festuca ovina* and wavy hair-grass. Amongst the grasses are patches of heath bedstraw *Galium saxatile*, creeping cinquefoil *Potentilla reptans* and heath rush *Juncus squarrosus*. Soft rush *J. effusus* occurs in a damper area near Bush Road, and nearby is some honeysuckle *Lonicera periclymenum*.

A colony of small-flowered balsam *Impatiens parviflora* noted by Lister (1941) and known then to have been establshed for thirty years or more has not been found in either section of Bush Wood; nor indeed have 28 other species (including three *Rubus* species covered in this survey by *R. fruticosus* agg.) mentioned in that paper. A list of these species is presented in Table 3. It should be noted that Lister's records refer to Bush Wood as a whole and may include plants from both Bush Wood North and Bush Wood (South).

In the list that follows (Table 1), an indication is given of the apparent frequency of occurrence and distribution of species and where relevant their approximate locations. However, as with the whole study area, more work needs to be done on the status of the plants. An account of the species occurring in each square of the recording maps is being made, and it is hoped that this will be deposited at the Biological Records Centre at the Passmore Edwards Museum, Stratford, when completed.

The sequence of plants in the Tables follows the order and scientific nomenclature of Clapham, Tutin and Warburg (1962). The letters and numerals after some of the entries in Table 1 refer to the squares shown in Fig. 1, each square being 0.25×0.25km. and aligned with the National Grid. Plants occurring on Leyton Flats and the adjacent areas are indicated, as are those found in Bush Wood North.

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TABLE 1. Plants recorded from Leyton Flats and Bush Wood North during 1980 and 1981.

Abbreviations
BWN Bush Wood North
LF Leyton Flats

PTERIDOPHYTA

Equisetum arvense common horsetail. LF. A few plants in B13 and E9.
Pteridium aquilinum bracken. LF. Common.
Dryopteris filix-mas agg. male fern. BWN. Uncommon. In F8 and F9.

GYMNOSPERMAE

Taxus baccata yew. LF.BWN. A few saplings in G8 and one in D14.

ANGIOSPERMAE: DICOTYLEDONES

Ranunculus acris meadow buttercup. LF. Common.
R. repens creeping buttercup. LF.BWN. Common.
R. bulbosus bulbous buttercup. LF. Less common than previous two species.
R. flammula lesser spearwort. LF. B13, B14, C13, D13.
R. ficaria lesser celandine. LF.BWN. One patch only on LF, in B13. More numerous in BWN. Near houses in F9 and G8.
Aquilegia vulgaris columbine. LF. One plant by roadside, D10.
Mahonia aquifolium Oregon grape. BWN. One plant near Blake Hall Road in G8.
Ceratophyllum demersum hornwort. LF. In Hollow Pond.
Meconopsis cambrica Welsh poppy. BWN. One plant by garden wall in F8.
Brassica oleracea cabbage. LF.BWN. A casual, usually by roadsides.
Cardaria draba hoary cress. LF. A large patch by Lea Bridge Road in B14.
Capsella bursa-pastoris shepherd's purse. LF.BWN. Common.
Cardamine pratensis cuckoo flower. LF. Uncommon. In damp hollows in B13.
Rorippa islandica marsh yellowcress. LF. Uncommon. By Hollow Pond, C13.
Alliaria petiolata garlic mustard. BWN. By house walls and in woodland, F9 and G8.
Sisymbrium officinale hedge mustard. LF. Scattered by roadsides and adjacent grassland.
Arabidopsis thaliana thale cress. LF. Only found on gravelly bare ground by Whipps Cross Road in B12.
Viola riviniana common dog-violet. BWN. A few patches at edge of woodland in G8.
Silene dioica red campion. LF.BWN. Uncommon. A12 and E8.
S. alba white campion. LF. Only by Hollybush Hill roadside in E10.
Cerastium holosteoides common mouse-ear. LF.BWN. Scattered in grassland.
Stellaria media common chickweed. LF.BWN. Common.
S. graminea lesser stitchwort. LF. Uncommon. B13 and E12.
S. alsine bog stitchwort. LF. One patch only found at south end of West Pond in A13.
Sagina procumbens procumbent pearlwort. LF. Only on bare gravelly ground in B12 and B13.
Spergularia rubra sand-spurrey. LF. On car-park area near lido in B13.
Chenopodium album fat hen. LF. Only by James Lane roadside in B11.
Atriplex hastata spear-leaved orache. LF. Uncommon. B10 and C11 south of Whipps Cross Road and D13 by ditch.
A. patula common orache. LF. C11 only, south of Whipps Cross Road.
Tilia×europaea common lime. LF.BWN. A tree by lido in B13, by Eagle Pond in D14, planted roadside trees in E9 by Highstone and Cambridge Park.
Malva sylvestris mallow. LF.BWN. A few plants in A13, C11, D11, E9, F8 and G8.
M. neglecta dwarf mallow. LF. One plant under a hawthorn in D11.
Geranium dissectum cut-leaved cranesbill. LF.BWN. Uncommon. In B12 and G8.
G. molle dove's-foot cranesbill. BWN. One or two plants in F9 near end of Woodcote Road.
G. robertianum herb robert. BWN. In woodland and by house walls in F8 and G8, including some white-flowered forms.

Oxalis europaea upright yellow sorrel. BWN. By house wall in F8.
Acer pseudoplatanus sycamore. LF.BWN. Common, especially as saplings.
A. platanoides Norway maple. LF. Saplings in lido enclosure in B13.
A. campestre field maple. LF.BWN. One small tree in E10; one or two trees in F8 and F9 with numerous saplings.
Aesculus hippocastanum horse-chestnut. LF.BWN. Scattered trees and saplings in C11, D13, D14 and F8.
Ilex aquifolium holly. LF.BWN. Common.
Laburnum anagyroides common laburnum. LF.BWN. A tree in C11 south of Whipps Cross Road; one by roadside in D10; two trees by house wall in G8.
Ulex europaeus gorse. LF.BWN. Common.
Sarothamnus scoparius broom. LF.BWN. Common.
Spartium junceum Spanish broom. BWN. By Bush Road in E8.
Medicago lupulina black medic. LF.BWN. Common in grassland and roadside locations.
M. arabica spotted medic. LF. Only in grass near Highstone roadside in E9.
Trifolium repens white clover. LF.BWN. Common.
T. pratense red clover. LF. Not as common as previous species.
Lotus corniculatus birdfoot trefoil. LF. D9, E9, E10.
Robinia pseudoacacia locust tree. LF. One tree by hospital fence in B12.
Vicia cracca tufted vetch. LF. Uncommon. B11, C11.
V. sativa common vetch. LF. Common.
Lathyrus pratensis meadow vetchling. LF. Only by Snaresbrook roadside in C14.
L. latifolius broad-leaved pea. LF. Scattered plants in B13, C14 and E9.
Rubus idaeus raspberry. BWN. A patch in F9.
R. fruticosus agg. bramble. LF.BWN. Common.
R. laciniatus cut-leaved bramble. BWN. F8.
Potentilla erecta tormentil. LF. Plentiful in parts of the north of LF. B13, B14, C14, D13 and E12.
P. reptans creeping cinquefoil. LF.BWN. Uncommon. B13, B14, and E9 near Highstone; also E8 by Bush Road in BWN.
Geum urbanum herb bennet. BWN. Uncommon. F9 and G8.
Rosa arvensis field rose. LF. Woodland in D14.
R. canina dog rose. LF. Uncommon. A13 and D14.
Prunus spinosa blackthorn. LF. Particularly near Whipps Cross Road at the west end of LF. Also C11 near James Lane and E9 near Highstone.
P. avium wild cherry. LF. A number of trees near and by Whipps Cross Road in A12, B11, B12 and C11.
P. laurocerasus cherry-laurel. BWN. Two seedlings in thick woodland in F8.
Crataegus oxyacanthoides Midland hawthorn. LF. One or two trees in B13.
C. monogyna hawthorn. LF.BWN. Common.
Sorbus aucuparia rowan. LF.BWN. Appears to be increasing in all areas as saplings. No mature trees.
S. aria whitebeam. LF. One sapling only, near James Lane in C11.
Pyrus communis pear. LF. One tree by Hollybush Hill in E10.
Malus sp. apple. LF. One tree south-west of car park area in C13. Some trees by Hollybush Hill in E10 and E11.
Platanus×hybrida London plane. LF.BWN. Near James Lane in C11 and east of railway in E9.
Epilobium hirsutum great willowherb. LF. Common.
E. parviflorum hairy willowherb. LF. Only in A13.
E. montanum broad-leaved willowherb. LF. Only in B13.
E. tetragonum square-stemmed willowherb. LF. Only in B13.
E. adenocaulon American willowherb. LF.BWN. Particularly in wetter habitats at the north and west ends of LF. Also F9 in BWN.
Chamaenerion angustifolium rosebay willowherb. LF.BWN. Common.
Circaea lutetiana enchanter's nightshade. LF.BWN. On LF only near James Lane in B11. More common in BWN in F8, F9 and G8.
Myriophyllum spicatum spiked water-milfoil. LF. In Hollow Pond.
Callitriche stagnalis common water-starwort. LF. On mud by damp hollow in B13.
C. platycarpa water starwort. LF. By south edge of West Pond in A13. (Apart from this and the previous record, distribution and status of *Callitriche* spp. have not been fully determined).
Hedera helix ivy. LF.BWN. Common in wooded areas.
Hydrocotyle vulgaris marsh pennywort. LF. Plentiful in damp hollows and around ponds in B13, B14 and C12.

Anthriscus sylvestris cow parsley. LF.BWN. Common.
Sison amomum stone parsley. BWN. A few plants at edge of woodland path in F9.
Aegopodium podagraria ground elder. LF. Scattered patches in C11, C14 and E9.
Heracleum sphondylium hogweed. LF.BWN. B11, C14, D14, E11, F8
Mercurialis annua annual mercury. LF. Uncommon. B10, C11, E9.
Euphorbia helioscopia sun spurge. LF. Two plants only found in disturbed ground in B13.
E. peplus petty spurge. LF.BWN. Uncommon. E9, F8, G8.
Polygonum aviculare knotgrass. LF. Roadsides, tracks and car park areas.
P. arenastrum small-leaved knotgrass. LF.BWN. In similar locations to previous species.
P. persicaria redshank. LF.BWN. Common in wetter areas.
P. lapathifolium pale persicaria. LF. Uncommon. D13.
P. hydropiper water-pepper. LF. Some patches in C13 and D13.
P. cuspidatum Japanese knotweed. LF. Near hospital in A12 and B10.
Rumex acetosella sheep's sorrel. LF.BWN. Very common in grassland.
R. acetosa common sorrel. LF. Uncommon. Grassland in D14.
R. crispus curled dock. LF.BWN. Common.
R. obtusifolius broad-leaved dock. LF.BWN. Very common.
R. sanguineus red-veined dock. LF. By south edge of West Pond in A13.
R. conglomeratus clustered dock. LF. A13, B13, B14, C11, C13, D14.
Urtica dioica nettle. LF.BWN. Very common.
Ulmus sp. LF. Only as stumps and suckers.
Betula pendula silver birch. LF.BWN. Particularly in the north part of LF. Some mature trees dead, but many saplings.
Carpinus betulus hornbeam. LF.BWN. A few trees near James Lane in B11 and C11; a tree in the wood in D11 and in E11; by Eagle Pond in D14; east of railway in E9 and one tree in BWN in F8.
Fagus sylvatica beech. LF.BWN. By Whipps Cross Road in C11; east of railway in E9 and a few trees in BWN in F8.
Quercus cerris Turkey oak. LF. C11 near James Lane and D10 in wood.
Q. robur English oak. LF.BWN. Common.
Q. borealis red oak. BWN. Two trees in F8.
Populus canescens grey poplar. LF.BWN. Common in places as mature trees and regenerating by suckers. By hospital in A12 and B12, and in BWN in E9 and F9.
P. tremula aspen. LF. A group of a few trees and many suckers in wood in D13.
P. ×*canadensis* hybrid black poplar. LF. A large tree in lido enclosure in B13 appears to be var. *marilandica*.
Salix alba white willow. LF. A tree in poor condition by Eagle Pond in D14, and apparently several on the islands of that pond.
S. caprea great sallow. LF. D14. (The identity of *Salix* trees on LF has not been thoroughly determined, although the following species appears to be more common.)
S. cinerea subsp. *atrocinerea* common sallow. LF. C12 and D13. See note above.
S. repens creeping willow. LF. Scattered patches in the north part of Leyton Flats. B13, C13, C14, D12 and D13.
Calluna vulgaris heather. LF. One patch only known, in grassland in D13.
Fraxinus excelsior ash. LF.BWN. Scattered trees and saplings A12, B12, C11, D11, D14 and F8.
Ligustrum ovalifolium Japanese privet. LF.BWN. Single bushes in B13, C11 and G8.
Forsythia×*intermedia* forsythia. BWN. A sucker from a plant in adjacent garden in F8.
Pentaglottis sempervirens green alkanet. LF. A few plants by the side of the car park area and Snaresbrook Road in C14.
Myosotis sylvatica wood forget-me-not. LF. Some patches in wood in B13 do not appear obvious garden escapes. A plant in E9 by building rubble tipped onto grassland.
Convolvulus arvensis field bindweed. LF.BWN. Uncommon. B10, B14, E8 and F8.
Calystegia sepium subsp. *silvatica* great bindweed. LF. More common on LF than previous species. A12, B10, B11, B12, C11 and C14.
Solanum dulcamara bittersweet. LF.BWN. Common.
Cymbalaria muralis ivy-leaved toadflax. BWN. On house walls and in adjacent woodland in F8. Some plants have white flowers.
Digitalis purpurea foxglove. BWN. By house walls in F8. A garden outcast.
Veronica chamaedrys germander speedwell. LF. Only on dumped rubble in E9.
V. hederifolia ivy-leaved speedwell. BWN. By walls of houses and woodland in F9 and G8.
Lycopus europaeus gipsywort. LF. Uncommon. C13, D13 and D14.
Melissa officinalis balm. BWN. By house fence in F5. A garden outcast.
Ballota nigra black horehound. LF.BWN. Common.
Lamium purpureum red dead-nettle. LF. By Hollybush Hill in E10.

L. album white dead-nettle. LF. A12, B12, B13, D14 and E8.
Plantago major great plantain. LF.BWN. Common.
P. lanceolata ribwort plantain. LF.BWN. Common.
P. coronopus buck's-horn plantain. LF. On bare, gravelly areas such as car parks and tracks in A13, B12, B13, B14, C11 and D10.
Campanula trachelium nettle-leaved bellflower. BWN. One or two plants in wood near Cambridge Park in F9.
C. persicifolia peach-leaved bellflower. BWN. Two plants in wood in G8. Probably deliberately planted or a garden escape.
Galium saxatile heath bedstraw. LF.BWN. Plentiful in D13, less common in E12 and F8.
G. aparine cleavers. LF.BWN. Uncommon on LF in A12, C14, D14 and E9; and in BWN in E9 and G8.
Sambucus nigra elder. LF.BWN. Very common in woodland.
Symphoricarpos rivularis snowberry. LF.BWN. Uncommon. South of Whipps Cross Road in C11 and woodland in G8.
Lonicera periclymenum honeysuckle. BWN. One patch in grass near trees in F8.
Bidens tripartita trifid bur-marigold. LF. By ponds in A13, B12, B13, C13, D13 and D14.
Senecio jacobaea common ragwort. BWN. Some plants by Blake Hall Road in G8.
S. squalidus Oxford ragwort. LF.BWN. Common.
S. vulgaris groundsel. LF. On disturbed ground by roadsides in various locations.
Tussilago farfara coltsfoot. LF. Patches in D10, D14 and E9.
Aster novi-belgii Michaelmas daisy. LF.BWN. A patch in C13 and by housewall in G8.
Bellis perennis daisy. LF.BWN. Particularly in short, mown grassland by roadsides.
Achillea ptarmica sneezewort. LF. In a woodland clearing in D13.
A. millefolium yarrow. LF.BWN. Common.
Tripleurospermum maritimum scentless mayweed. LF. By hospital fence in A12.
Matricaria matricarioides pineapple weed. LF.BWN. On disturbed ground such as footpaths in various locations.
Chrysanthemum parthenium feverfew. LF. Uncommon. Only near James Lane in B11 and C11.
Artemisia vulgaris mugwort. LF.BWN. Particularly by roadsides.
Arctium minus lesser burdock. LF. Particularly by roadsides.
Cirsium vulgare spear thistle. LF.BWN. Common.
C. arvense creeping thistle. LF.BWN. Common.
Centaurea nigra black knapweed. LF. By Snaresbrook Road in D14.
Lapsana communis nipplewort. LF.BWN. Only near James Lane in C11 and by car park in D14.
Hypochoeris radicata common cat's-ear. LF.BWN. Common.
Tragopogon pratensis goat's-beard. LF. Mostly in roadside grassland by hospital in B11 and B13. Also by Snaresbrook Road-side in C14.
Sonchus oleraceus smooth sow-thistle. LF. Uncommon. A12, B10, B14, E9.
Crepis vesicaria beaked hawk's-beard. LF.BWN. Occurs in A12, B14, C14, D10, E9, E10 and E8.
C. capillaris smooth hawk's-beard. LF. Only in A13.
Taraxacum officinale agg. dandelion. LF.BWN. Common.

ANGIOSPERMAE: MONOCOTYLEDONES

Elodea canadensis Canadian pondweed. LF. In Hollow Pond and adjacent small pond in C12 and C13.
Lagarosiphon major curly water-thyme. LF. In Hollow Pond in 1980 and 1981, but not plentiful.
Poatamogeton pusillus lesser pondweed. LF. In Hollow Pond and adjacent small pond.
P. obtusifolius grassy pondweed. LF. In Hollow Pond, adjacent small pond and West Pond.
P. trichoides hair-like pondweed. LF. In Hollow Pond, adjacent small pond and West Pond.
Chionodoxa sardensis glory of the snow. BWN. One plant in wood near houses, from which it probably originated. F8.
C. luciliae glory of the snow. BWN. A few plants of garden origin near junction of Blake Hall and Bush Roads in F8.
Hyacinthus orientalis hyacinth. BWN. By garden fence in F8, either deliberately planted or a garden outcast.
Ornithogalum umbellatum star of Bethlehem. LF. Some plants in grassland at edge of wood in D11.
Endymion non-scriptus bluebell. LF.BWN. Scattered, but nowhere common, and mostly appearing introduced.

E. hispanicus Spanish bluebell. LF. One or two plants by lido fence in B13.
Muscari sp. grape-hyacinth. BWN. A small grape-hyacinth by house fence in F8.
Juncus squarrosus heath rush. LF.BWN. Widely scattered in grassland and woodland clearings, particularly in the north of LF.
J. tenuis slender rush. LF. A patch at the north edge of the small pond in C13 and a patch in wet grassland near hospital in A12.
J. bufonius toad rush. LF. A12, B13, B14, C13, D13, D14.
J. inflexus hard rush. LF. A13, C13, D14 and E10.
J. effusus soft rush. LF.BWN. The most common rush.
J. acutiflorus sharp-flowered rush. LF. In a wet hollow on the east side of the road to the lido in B13.
J. articulatus jointed rush. LF. B13, B14, C12, C13, D13.
J. bulbosus bulbous rush. LF. Wet areas in B13 and B14.
Luzula multiflora many-headed woodrush. LF. In grassy areas at north edge of LF. B13, D13 and D14. Both tight and loose-headed forms occur.
Narcissus spp. daffodils. LF.BWN. Scattered individuals in E10 and E11, F8 and F9 are obvious introductions.
Iris pseudacorus yellow flag-iris. LF. By Hollow Pond in B12 and by West Pond in A13.
Iris sp. garden iris. LF.BWN. One between West Pond and road in A13 and another by garden wall in F8 are garden outcasts.
Crocus sp. garden crocus. BWN. By house wall near Cambridge Park in F9. Of garden origin.
Lemna minor common duckweed. LF. In small marshy area in wood in B13 and by Hollow Pond and Eagle Pond.
Typha latifolia great reedmace. LF. By Hollow Pond in B12 and C13.
Eleocharis palustris common spike-rush. LF. By Hollow Pond in B13 and C13.
Eleogiton fluitans floating scirpus. LF. In North Pond, B14.
Carex panicea carnation-grass. LF. A small quantity in open grass area of D13.
C. hirta hairy sedge. LF. Occurs in A12, C11, D9 and D14.
C. nigra common sedge. LF. In D13 and D14.
C. remota remote sedge. LF. One clump by Eagle Pond in D14.
C. ovalis oval sedge. LF. Perhaps the most common sedge. In B13, C13, D13, D14, E11, E12.
Molinia caerulea purple moor-grass. LF. Uncommon. In E11.
Sieglingia decumbens heath grass. LF. In B13 and C13.
Glyceria fluitans floating sweet-grass. LF. B13, B14, C13, D13.
G. maxima great water-grass. LF. Abundant by West Pond in B13 and B14. Also by Hollow Pond in C13.
Festuca rubra subsp. *rubra* red or creeping fescue. LF.BWN. B13, C12, D12, D13 and F8.
F. ovina sheep's fescue. LF.BWN. B13, C14, E8 and F8.
F. tenuifolia fine-leaved sheep's fescue. LF. C12 and C14.
Lolium perenne perennial rye-grass. LF.BWN. Common.
Poa annua annual meadow-grass. LF. Common on LF.
P. pratensis smooth meadow-grass. LF.BWN. D11, D12, D14 and F8.
P. trivialis rough meadow-grass. LF. B13 and D14.
Dactylis glomerata cock's-foot. LF.BWN. Very common.
Cynosurus cristatus crested dog's-tail. LF. Only in the south part of LF, in B14, C11, D11 and E11.
Zerna erecta upright brome. LF. On almost bare ground by Hollow Pond in C12.
Anisantha sterilis barren brome. LF. Uncommon. Near James Lane in B11; at the edge of wood in D10; by Hollybush Hill in E10.
Bromus mollis soft brome. LF. D11.
Agropyron repens couch. LF.BWN. North and south of Whipps Cross Road in C11, D11, D14, E8 and F8.
Hordeum murinum wall barley. LF.BWN. Scattered, often by roadsides.
Arrhenatherum elatius false oat-grass. LF.BWN. B11, E10 and F8.
Holcus lanatus Yorkshire fog. LF.BWN. D14, E12 and E8, F8.
H. mollis creeping soft-grass. LF.BWN. E12 and E8, F8.
Deschampsia caespitosa tufted hair-grass. LF. Uncommon. B13 and D13.
D. flexuosa wavy hair-grass. LF.BWN. C12, C13, E10, E12 and F8.
Aira praecox early hair-grass. LF. On a path at north end of West Pond in B13.
Agrostis canina subsp. *canina* velvet bent. LF. Abundant in North Pond, C14.
A. canina subsp. *montana* brown bent. LF. B13, C13, D12, D13, D14.
A. tenuis common bent. LF.BWN. Common.
A. gigantea black bent. LF. Only recorded from C14.

A. stolonifera creeping bent. LF. Only recorded from B14.
Phleum bertolonii smaller cat's-tail. LF.BWN. A12, B11, B13, B14 and E8, G9.
P. pratense timothy grass. LF. Only recorded from B13.
Alopecurus pratensis meadow foxtail. LF.BWN. C11, C13, D11, D12, D14 and F8.
A. geniculatus marsh foxtail. LF. Damp areas in A13, B13, C11, C13 and D11.
Anthoxanthum odoratum sweet vernal-grass. LF. Woodland clearings in D13 and D14.
Phalaris arundinacea reed canary-grass. LF. By Hollow Pond in C13.
Nardus stricta mat-grass. Common in grassland, abundant in some squares. Also in woodland clearings. B13, B14. C14, D11, D12, D13 and E11.

TABLE 2. Species included in *The Flora of Essex* (Gibson 1862) from the vicinity of Leyton Flats, and not found in the present survey.

Abbreviations of recorders' names

F.	Forster, Edward, F. L. S.	J. T. S.	Syme, J. T., F. L. S.
G.	Gibson, G. S.	W. L.	Lister, William Henry.
J. F.	Freeman, J.	W. G.	Garnons, W. L. P.

Athyrium filix-femina. Snaresbrook. F.
Dryopteris dilitata. Snaresbrook. W. G.
Thelypteris limbosperma. Nr. Snaresbrook. F.
Chenopodium urbicum. Snaresbrook.
Oxalis acetosella. Snaresbrook. J. F.
Frangula alnus. Snaresbrook, not common. F.
Ulex minor. Leytonstone. W. G.
Ononis spinosa. Epping Forest near Stratford. J. F.
Trifolium medium. Snaresbrook. W. G.
Ornithopus perpusillus. Epping Forest near Stratford. J. F.
Rubus leucostachys. Sm. Snaresbroom. W. G.
R. carpinifolius. W. & N. Snaresbrook. F.
(Note: *Rubus* spp. covered in present survey by *R. fruticosus* agg.)
Drosera rotundifolia. Between Leytonstone and Snaresbrook Gough.
Peplis portula. Epping Forest, Stratford. J. F.
Epilobium palustre. Snaresbrook. F.
Apium inundatum. Snaresbrook. W. G.
Rumex pulcher. Nr. Leytonstone. F.
Salix aquatica Sm. Common on the Forest. F.
Erica tetralix. Snaresbrook. G.
Hyoscyamus niger. Forest near Snaresbrook. F.
Pedicularis palustris. Forest near Stratford. J. F.
Mentha×piperits. Near Whipps Cross. F.
Viburnum lantana. Snaresbrook. W. G.
Chamaemelum nobile. Leytonstone. W. G.
Serratula tinctoria. Forest near Snaresbrook, very uncommon. F.
Damasonium alisma. Snaresbrook. J. F.
Zannichellia palustris. Snaresbrook. W. G.
Juncus subnodulosus. Snaresbrook. W. G.
Lemna polyrhiza. Snaresbrook. G.
L. gibba. Forest near Leytonstone. F.
Eleocharis quinqueflora. Bog on Epping Forest, between Wanstead and Walthamstow. F.
Carex flava. Snaresbrook. W. G.
C. riparia. Snaresbrook. W. G.
C. pulicaris. Between Walthamstow and Wanstead.
Catapodium rigidum. Snaresbrook. W. G.

TABLE 3. Species included in *The Flora of Wanstead Park District* (Lister 1941) as being present in Bush Wood, but not found there during the present survey.

Ranunculus flammula
Lepidium ruderale
Cerastium glomeratum
Prunus amygdalus
P. cerasus
Peplis portula

Oxalis acetosella
Impatiens parviflora
Trifolium hybridum
Lathyrus pratensis
Rubus cardiophyllus
R. pallidus Weihe.
R. radula
(Note: *Rubus* spp. covered in present survey by *R. fruticosus* agg.)
Waldsteinia trifolia
Rosa arvensis
R. canina
Epilobium parviflorum
Callitriche platycarpa
C. hermaphroditica
Ligustrum vulgare
Calystegia sepium subsp. *sepium*
Stachys sylvatica
Galium verum
Bidens cernua
Luzula campestris
Sparganium emersum
Carex nigra
Glyceria plicata

Book Review

Docks and knotweeds of the British Isles: B.S.B.I. Handbook No. 3. By J. E. Lousley and D. H. Kent. 205 pp., 80 illus. Botanical Society of the British Isles, London, 1981. £5.50.

Those who already have the previous two volumes, on sedges and umbellifers, will eagerly purchase this addition to the series. The well-proven format is unchanged — soft-bound, pocket-sized, with full-page line drawings opposite the relevant text, and a complete set of keys to genus, species and subspecies. And a glossary, too.

It is based on the early drafts and notes by the late J. E. Lousley, who made a special study of the family Polygonaceae, especially so the genus *Rumex*. Alas, Ted Lousley died in 1976 leaving the manuscript only partially completed; we are very fortunate that D. H. Kent was willing to accept the challenge (and the work!) and complete the monograph, in spite of having no special knowledge of the family. But his expertise in the bibliography of British plants, on a world-wide scale, have doubtless even added facets that Mr. Lousley would have missed: there are eight pages of references for us to chase up, if we wish to learn more.

The genera *Rumex* and *Polygonum* are rich in alien species, and the London Area must be one of the best areas to see many of them, so their full treatment herein is especially valuable to our members. Even a rare casual like *Polygonum pensylvanicum* receives the full two-page allocation, whereas the (rarer still) two *Emex* species share two pages.

The artwork, as in the umbellifers volume, is by Ann Davies. She beautifully and accurately portrays the 'jizz' of the plants. Her enlargements of critical parts are sometimes less convincing and suggest, perhaps, a lack of taxonomic craft — e.g. the penduncle of *Polygonum nodosum* has, surely, Compositae pappus adhering to its subsessile glands (admittedly a usual state of affairs in the field and herbarium!), whilst the stigmas on the nutlet are shown almost style-less. I much dislike all the scales of the drawings being transferred to a key on page 12, but the artist did not make this choice.

The text and nomenclature are commendably up-to-date and sound. Misprints are very few, but silly 'slips' often catch the eye, like 5.3mm instead of 3.5mm (p.56), or flowers 3cm instead of 3mm (p.72). On the plate of *Polygonum patulum* and *P. arenarium*, the labels 11 and 12 should be interchanged; this pair of species, as the text emphasises, have long been confused! Most curiously, *Rumex confertus* is claimed only as a 'casual' in Surrey: yet, it persisted in a rough field at Old Coulsdon from 1942-60 — such a powerfully rhizomatous (unmentioned in description) species is not easily eliminated from anywhere. Beware of the list of '*Rumex* hybrids recorded from the British Isles' at the back of the book — those, like *R. crispus* x *longifolius*, treated earlier in the book, are, confusingly, not referenced at all. There is a long and helpful index of species names, but some synonyms appearing in our older local floras do not feature; nor does *R. pulcher* ssp. *anodontus* that *is* in this book; nor is page 110 given for *R. arifolius*, which has more information than the refereneed page 169.

But, I am nit-picking ... this is a very good book; use it intelligently and learn much more about the Polygonaceae, which you will soon discover is not such a dull family as maybe once you imagined. You can make a meal of several of the species.

E. J. Clement

The Macrofauna of the Thames Estuary

by M. J. Andrews*, K. F. A. Aston*, D. G. Rickard† and J. E. C. Steel†

Summary

This article describes the distribution of macrofauna in the Thames estuary and presents the most comprehensive species list so far published. It indicates how recolonisation has occurred in previously polluted areas, and the information will be used to provide the basis for a report on the biological quality of the Thames estuary to the Commission and Member States of the European Economic Community and to the Paris Commission.

Introduction

Plans designed to alleviate the problem of severe pollution of the Thames estuary were implemented in the mid 1950s. The improvement of effluent quality from London's main sewage treatment works at Beckton and Crossness has been the major influencing factor on water quality in the brackish reaches. The first obvious signs of this improvement appeared in 1964 when dissolved oxygen levels became sufficiently high for some fishes and macroinvertebrates to survive in the inner estuary.

Some authors suggested that recovery of fishes had already occurred by 1967 (Gameson and Wheeler 1977) whilst others considered that fish abundance was still limited by the low dissolved oxygen levels in the water in 1970 (Huddart and Arthur 1971*b*). Sedgwick (1979) recorded a level of abundance and variety of fish life at the intake screens of Tilbury Power Station in 1973 that indicated a continuing improvement. This was borne out by Andrews and Rickard (1980) who found that the estuarine fish populations were still developing until 1977, when a population structure indicating freedom from pollution stress was first recorded for fish at West Thurrock Power Station.

The recovery of macroinvertebrates is less well documented. Earlier workers recorded populations that were typical of polluted conditions, with a superabundance of tolerant species such as members of the Tubificidae — and a paucity of representatives of other taxa (Huddart 1971; Birtwell 1972).

This account, covering the period 1974-1981 provides up-to-date knowledge of the Thames estuary macrofauna and sets new baselines against which to measure any future changes in water quality.

Earlier surveys

The most informative early work on Thames fishes is by Murie (1903). A. L. Wells (undated notes) has usefully summarised Murie's reports into a list of species and their abundance. More recently, Wheeler (1979) has published details of the fish species in the estuary, the major part of his book being the results of observations made during a study of the tideway up to 1973. Wheeler's findings have not been reiterated in this paper except where information given in his book has been used to illustrate changes in fish populations that have occurred recently. Some further information regarding fish in the Thames is provided by Huddart (1971) from his research between 1967-70 and by Sedgwick (1979) working from 1971-73.

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Recent investigations on invertebrates in the brackish regions have been mainly restricted to studies of Tubificidae (Birtwell 1972; Birtwell and Arthur 1980; Hunter and Arthur 1978) and *Crangon* (Huddart and Arthur 1971*a*; Sedgwick 1979). Murie (MS) provides information concerning invertebrates found in the 19th century. Surveys carried out in the fully marine environment at Maplin Sands and in the Deeps beyond Sea Reach have been reported by Kay and Knights (1975) and Shelton (1971) respectively. A list of marine species found off the Kent coast at Whitstable is provided by Newell (1954) and later supplemented by Maghraby and Perkins (1956).

The Survey Area

For the purposes of this report the Thames estuary is considered as the length of river flowing through London and bounded to the west by the tidal limit at Teddington and at the seaward end by an arbitrary line joining Haven Point in Essex and Warden Point on the Isle of Sheppey in Kent. The estuary is divided for ease of reference into seven sections, numbered I to VII, and the marine zone, VIII, as shown in Fig. 1.

The salinity gradient pertaining to the estuary is given diagramatically in Fig. 2, where a curve showing the ten-year (to 1978) average half-tide corrected salinity has been drawn. The water above London Bridge is normally fresh and contains predominantly freshwater organisms, but below London Bridge over a distance of some 15km the water becomes brackish, and estuarine species appear. The mesohaline reaches, with their typically estuarine biota, occur between Woolwich (5‰S) and Gravesend (18‰S). Beyond Gravesend, marine organisms predominate and at the seaward limit of the estuary almost fully marine conditions are found. Under conditions of drought, or in periods of prolonged rainfall, the salinity regime for the middle and inner estuary may vary considerably from the average values indicated by the salinity curve in Fig. 2.

The bed material for much of the estuary consists of gravel, stones, clay or chalk. Exceptions are areas where siltation occurs, as in the three consecutive reaches immediately seaward of the main entrances to the Royal Docks. These are referred to collectively as the 'mud reaches' and the presence of silt is important in determining the type of organisms found in zone III. Severe siltation also occurs at the seaward end of Gravesend Reach (V). In Sea Reach and beyond (VI-VIII) the bed material is mainly fine sand.

Intertidal areas along the estuary vary in their component substrates, but generally consist of walls and embankments below which are areas of mud, silt, and shingle or sand. Rocks and chalk boulders occur on the upper shore at many locations and are generally covered by growths of *Blidingia* and *Enteromorpha*. Seaward of zone III, hard substrates on the lower and middle shores are covered by dense fucoid growths. In Sea Reach at low tide, large areas of mudflats are exposed, but there are also areas of foreshore which are covered by mussel beds, banks of shell or consolidated shingle.

Survey methods

The three main methods used for sampling estuarine macrofauna were shore-collecting, trawling and removal of entrapped organisms from power station cooling water screens. A survey of the benthos was performed using bottom-sampling grabs, but problems occurred which limited the success of this potentially very useful method.

(i) Shore-collecting

Epifauna was collected from areas alongside permanent shore transects set out from the low water mark to the splash zone. Macroinfauna was sieved from mud and sand samples. Most organisms were identified on site and their abundance

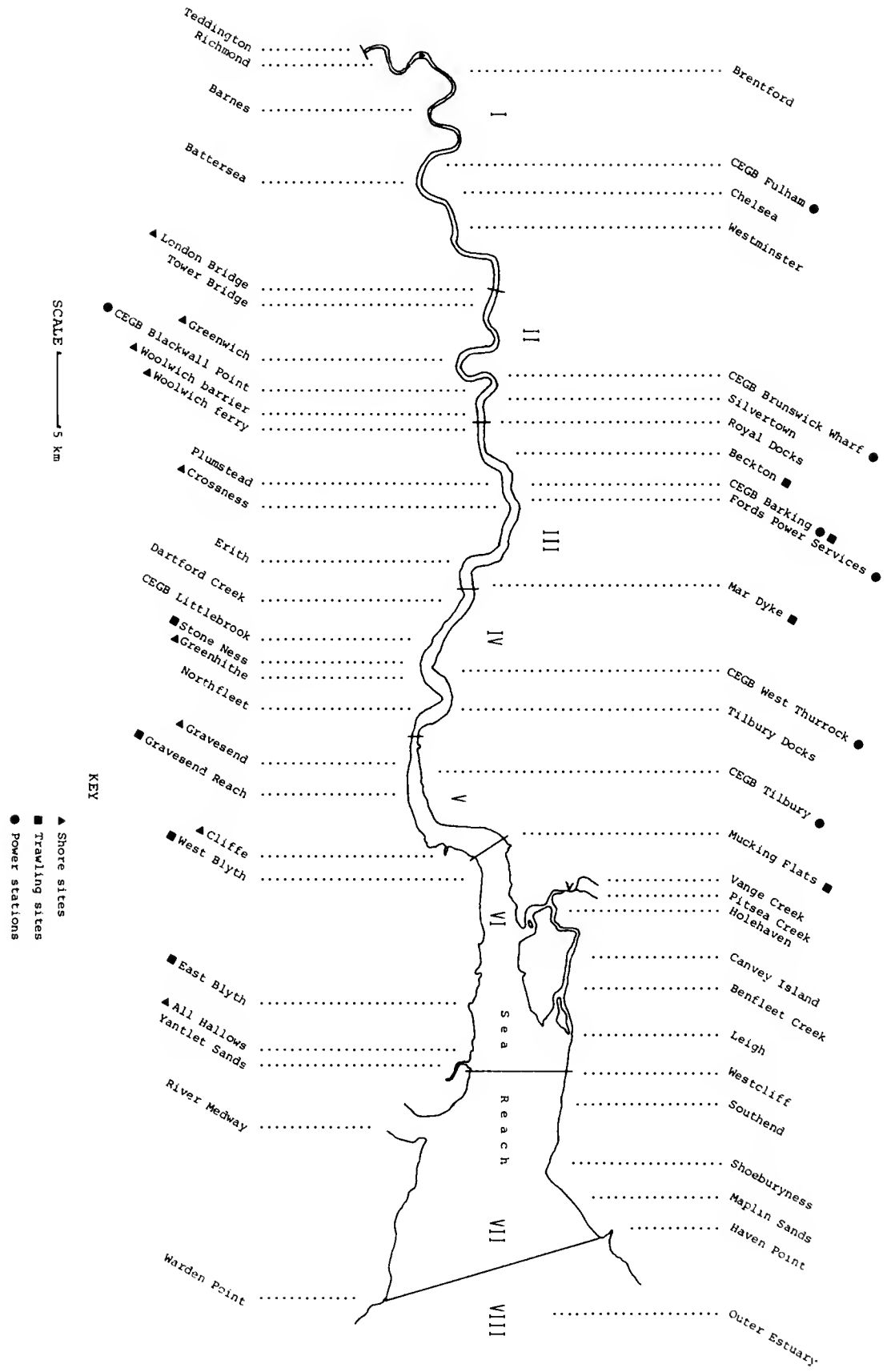
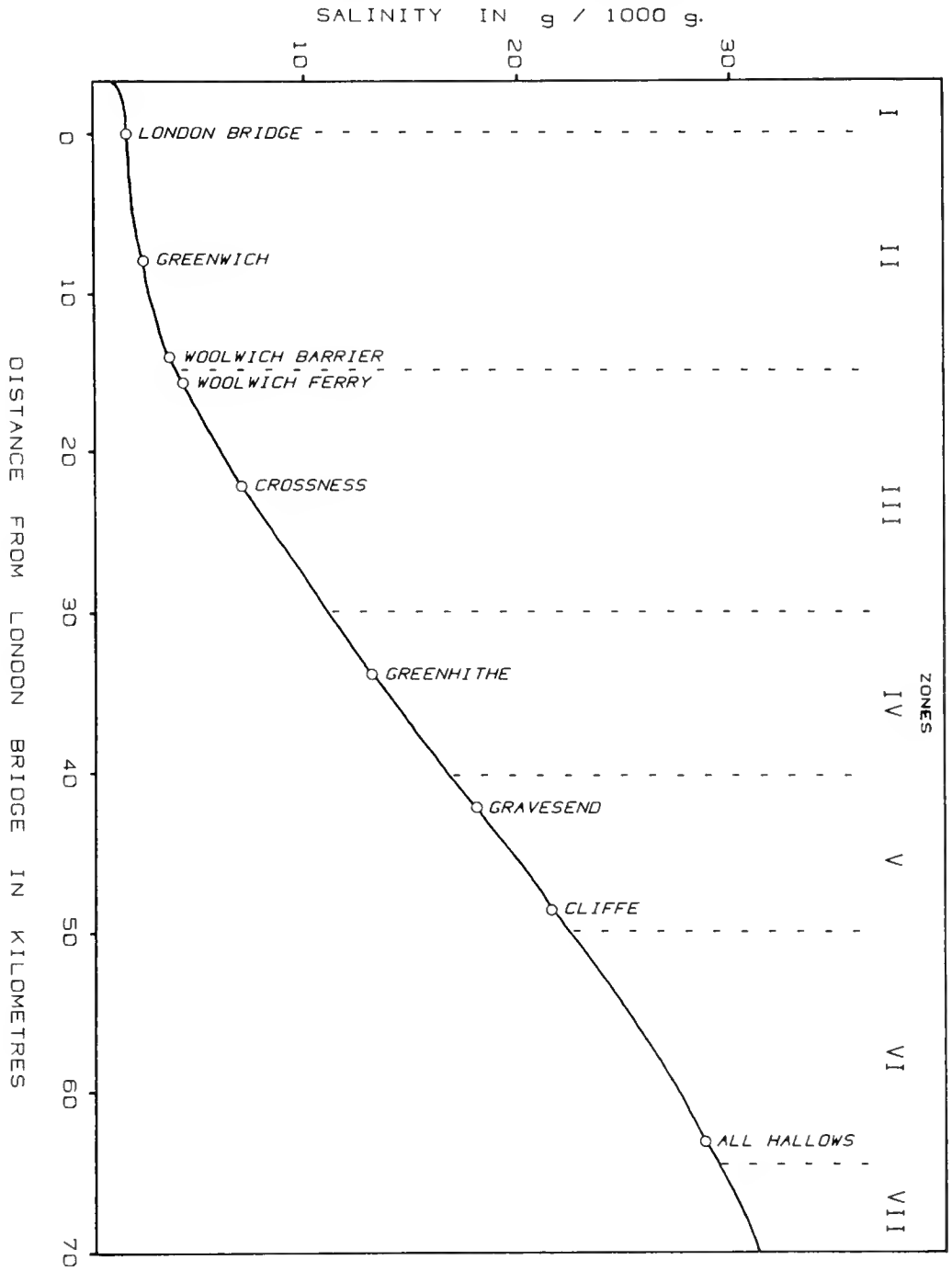


FIG. 1. Map of the Thames estuary showing places mentioned in the text.

assessed, but a few requiring microscopical examination were removed to the laboratory.

Nine shore sites along the southern bank of the estuary were each visited four times a year. Their locations were as follows:-
London Bridge (I), Greenwich (II), Woolwich — barrier site (II), Woolwich — ferry site (III), Crossness (III), Greenhithe (IV), Gravesend (V), Cliffe (V) and Allhallows (VI).

FIG. 2. Half-tide corrected salinity curve for the Thames estuary.



(ii) Beam trawling

A two-metre beam trawl, fitted with half-inch mesh shrimp netting was used to catch bottom-living fish and invertebrates.

During 1975-77 trawling was carried out throughout the estuary, but after 1978 sampling effort was restricted to the following locations:-

Blyth Sands (VI) — opposite E. Blyth buoy.
Blyth Sands (VI) — opposite W. Blyth buoy.
Mucking Flats (V) — between Mucking Creek and No. 1 Mucking buoy.
Gravesend Reach (V) — off C.E.G.B. Tilbury Power Station.
Long Reach (IV) — near Stone Ness.
Long Reach (III) — upriver of Mar Dyke.
Barking Reach (III) — seaward of C.E.G.B. Barking Power Station.
Gallions Reach (III) — off Beckton Gas Works.

(iii) Power station sampling

Several Thames side power stations using estuary water for direct cooling were visited during the survey. Quantitative assessment of the fauna was possible at West Thurrock (IV) by relating numbers of animals caught on the intake screens to the volume of throughput water, which approximated 100 millions during each visit. Between 1975 and May 1976 surveys were carried out on a monthly basis. Since then, fortnightly samples have been taken, coincident with each spring tide. Sampling began at local low water and continued for up to six hours.

At the other power stations shown in Fig. 1, organisms were either picked off the screens during a one- or two-hour period each month, or were collected from bins of preservative into which they had been placed by station employees.

(iv) Other sampling methods

In 1975 an extensive sampling programme was carried out between Erith and Westminster using a small Ekman-Birge grab sampler. In April 1978 a more efficient Day grab was used successfully in the outer estuary but could not subsequently be used because a vessel with suitable lifting gear was not then available. In 1981 a push-net was used to sample sub-littorally in zones I-IV.

Results

Recent records for invertebrates and fishes found in the Thames estuary have been compiled into two sections. A table of species found is included at the end of each section. With the exception of those animals indicated by an asterisk, all have been identified from the present survey. A few nominally freshwater invertebrates have been included, but only those known to penetrate well into zone II and seaward. The occurrence of freshwater macroinvertebrates in zone I has been reported previously in *The London Naturalist* by Aston and Andrews (1978). Freshwater fishes found mainly in zones I and II have been included since their greater mobility compared with the freshwater invertebrates allows many of them to penetrate into zones III and IV, especially under conditions of high river flows.

SECTION I — MACROINVERTEBRATES FOUND IN THE THAMES ESTUARY

COELENTERATA

'Whiteweed', a general term for foliate hydroids (of which *Sertularia* spp. are the most widespread) has been gathered commercially for many years from the Thames estuary where it is found commonly from Sea Reach outward (VII-VIII). Hancock *et al.* (1956) reported *S. argentea* as being the commercially trawled species in the Thames. It also provides a habitat for many small invertebrates such

as the isopod *Idotea linearis*, the sea-spider *Pycnogonum littorale* and various amphipods, including the caprellid *Caprella linearis* and many of the Gammaridea.

Two jellyfish species are found in the tideway but only one, *Aurelia aurita* is common. This is a regular visitor from mid-June to October, generally penetrating upriver to zone II. The second species, *Chrysaora hysoscella*, has been found on a few occasions during June and July, mostly from Sea Reach (VI).

Other coelenterates such as sea-anemones have been observed, but due to difficulty in identification, these have not been included in Table II.

CTENOPHORA

Pleurobrachia pileus, the sea gooseberry, stays in the estuary for all but the winter months. Murie (MS) reported that whitebait fishermen called the medusoids of *Aurelia* 'flat gall' and the sea gooseberries 'nut gall' and that they severely hampered fishing activities by clogging nets in the summer months — much as they do nowadays on our surveys.

ANNELIDA

(i) Polychaetae

In total, 40 species of polychaetes have been identified, ranging from a single species in zone II to 23 species in the marine zone (VIII).

The inner, mud reaches (II-V) contained mostly members of the Nereidae, Spionidae and Capitellidae, the single species found ubiquitously being *Neanthes diversicolor*. This worm demonstrated the highest upriver penetration and was found at all sites intertidally. Greatest densities were recorded in firm mud towards the upper shore, for example at Greenhithe (IV), 50-100m^{-2} may be found at only 2m above chart datum, increasing progressively up to the shore to around 3000m^{-2} at 4m above c.d.

Neanthes diversicolor is a key member of the estuarine food web. It is heavily predated by overwintering birds (Harrison and Grant 1976) and was found to be the chief prey of redshank and curlew at Southend (VII) by Goss-Custard *et al.* (1977). *N. diversicolor* is eaten by most fish species, although Sedgwick (1979) found it to be a major diet item only in eel, flounder, plaice and sole. Sedgwick recognised four feeding groups corresponding broadly with vertical feeding levels, as shown in his table reproduced in Fig. 3. An inverse relationship between densities of *N. diversicolor* and the tubificid *Peloscolex benedeni* on the shore was noted, similar to that reported for the River Medway by Wharfe (1977).

Neanthes succinea was much more limited in distribution, being found predominantly in zones IV and V both sub-littorally and in firm mud on the lower shore. *N. virens*, although the subject of a study in the outer Thames esuary (VII) (Bass and Brafield 1972) and reported by Newell (1954) as widely distributed in the Whitstable area, was not recorded in this study.

The spionid *Polydora ciliata* was another common polychaete in the tideway. The majority of specimens were taken in trawls, particularly from zone V outward, with very high densities being found in firm mud or in the clods of compacted vegetation common at Tilbury (IV/V).

Another spionid, *Streblospio* sp. has however been taken only from the shore. Found in increasing numbers since 1977 the species has colonised the lower shore in sandy mud at Gravesend (V) and additionally since 1979 at Greenhithe (IV). The worm does not fit the description of the *S. benedicti* monotype (Light 1978) especially in the following features:

The single sabre neurosetae start at least in setiger three and possibly are present also in setigers one and two. (In *S. benedicti* these are not present before setigers six or seven). The teeth of the neuropodial hooded hooks are in a single row, with five or six teeth

above the main fang, of decreasing length (not a double row of long stout teeth as in *S. benedicti*).

The single pair of branchiae on setiger one which is diagnostic for the genus has never been observed, although these are easily shed, as are the grooved palps, in spionids.

Also occurring at the Gravesend (V) and Greenhithe (IV) sampling sites and found irregularly elsewhere within zones II to VI was the capitellid *Capitella capitata*. The only shore records of the lug-worm *Arenicola marina* and the catworm *Nephtys hombergi* have been from the Allhallows (VI) site. Most specimens of *N. hombergi* have been taken in trawls. Kay and Knights (1975) and Goss-Custard *et al.* (1977) have reported this species in high numbers in the soft sediment around Southend (VII) from an area not sampled in this survey.

The only region studied in any detail on the north shore was the system of creeks around Canvey Island. *Cirratulus filiformis* was frequently found in Benfleet, Vange and Pitsea Creeks, although rarely recorded on the southern shore. *Caulleriella zetlandica* was not positively identified during this survey although it was noted by Hunter and Arthur (1978) during 1972-73 at Cliffe (V) and by Wharfe (1977) in the nearby River Medway.

Most specimens of the fan-worm *Sabella penicillis* and the tube-worm *Pomatoceros triqueter* have been taken in trawls from Gravesend (V) outwards, the tubes generally being attached to empty mollusc shells or small stones. Another serpulid, *Mercierella enigmatica*, was found mostly on the lower shore on rocks at Greenhithe (IV), Gravesend (V) and Cliffe (V).

Members of the Terebellidae, Polynoidae and Phyllodocidae were frequently taken in trawls from Sea Reach outwards (VI-VIII). However, on the single occasion that a Day grab was used in the Barrow Deep (VIII), 12 species were identified which had not shown on previous occasions, thus demonstrating the superiority of the benthic grab sampling method for polychaetes.

The polychaete fauna in general was very varied in the Barrow Deep, the families represented including many mentioned by Shelton (1971) as occurring in the nearby Black Deep (VIII).

(ii) Oligochaetae

Within the brackish region (II-VI), 11 oligochaete species were recorded including members of the Tubificidae, Naididae and Enchytraeidae. The gradation of species both littorally and along the estuary is dependent on a variety of factors. Birtwell and Arthur (1980) investigated several of these and concluded that it was salinity followed by, or in combination with, dissolved oxygen levels which was the major influence on distribution of species in the Thames, whilst particle size affected abundance.

Tubifex tubifex and *Limnodrilus hoffmeisteri*, with salinity tolerances of up to 3.5°/oo and 6°/oo respectively (Birtwell 1972) were generally confined to zones I and II although *T. tubifex* was recorded as far downriver as Crossness (III) and *L. hoffmeisteri* to Greenhithe (IV) on occasions. Andrews (1977) reported a reduction in density of these worms at London Bridge (I/II) from the 300,000m^{-2} reported by Birtwell (1972) in 1971 to a maximum of 4000m^{-2} by June 1975. The decline in numbers may be due to increased predation and to the decrease in siltation and organic content since the general cleaning up of the river. *Clitellio arenarias* is the dominant species in the upper shore at all sites downriver of Woolwich (III). *T. costatus* is now numerically dominant in the Woolwich mudflats occurring with *T. tubifex*, *L. hoffmeisteri* and occasionally *T. pseudogaster*, *Psammoryctides barbatus* and the naid *Paranais litoralis*. However, Birtwell (1972) found *L. hoffmeisteri* to be the dominant species in this region in 1971, due, he concluded, to the greater tolerance of low dissolved oxygen levels by *L. hoffmeisteri* compared to *Tubifex* species. The penetration of *T. costatus* upriver

and the greater diversity of species now found reflects the much improved aerobicity of the Thames in this region.

Tubifex costatus has a very wide range of salinity tolerance of from 2°/oo to full seawater (Green 1968) which accounts for its wide distribution between Greenwich (II) and Cliffe (V). This worm is most abundant at Crossness (III) where it occasionally exceeds 100,000m^{-2} and provides a major food source both for overwintering wildfowl (Grant, Swift and Harrison 1973) and certain demersal fish (Sedgwick 1979). The upriver limit of the more marine *Peloscolex benedeni* (=*Edukemius benedii* of Holmquist, 1978, 1979) is at Greenhithe (IV). The shore here and further downriver at Gravesend (V) includes both *P. benedeni* and *T. costatus* together with *T. pseudogaster* and *Monopylephorus rubrinoveus*. At Cliffe (V) the Tubificidae are represented primarily by *P. benedeni* and *T. costatus*, with densities rarely exceeding 50,000m^{-2}. *P. benedeni* was the subject of a study by Hunter and Arthur (1978) between 1972-73, who recorded densities of up to 142,000m^{-2} *P. benedeni* in association with *T. costatus* and the polychaete *Caulleriella* sp. at Cliffe (V).

At Allhallows (VI), the furthest shore sampling site downriver, *T. costatus* is eliminated, due either to the more sandy substrate or through competition with *P. benedeni* which dominates the mid-shore zone.

ARTHROPODA

CRUSTACEA

(i) Cirripedia

Balanus improvisus is the most widespread barnacle in the Thames. It is the species most tolerant of reduced salinities, with a range extending from the Woolwich Ferry (III), where it is found frequently in small numbers, to the marine zone (VIII). *B. improvisus* reaches an abundance peak in the Greenhithe (IV) and Gravesend (V) areas up to mid-tide level.

Elminius modestus has an upriver penetration limit of Greenhithe (IV) but is most abundant on the upper shore in the more saline areas of Cliffe (V) and Allhallows (VI). This barnacle was introduced from Australasia in the 1940s and spread to the Thames estuary from Southampton Water. It was reported as the most common barnacle on the north Kent coast by Newell (1954) and in the lower Medway by Wharfe (1977). The more extensive breeding season, rapid growth rate and greater tolerance of temperature and lowered salinities of *E. modestus* have contributed towards its successful competition with indigenous species such as *Balanus balanoides*. Although able to tolerate salinities down to 14°/oo *B. balanoides* is, in the Thames, confined to the marine zone (VIII). Wharfe (1977) reported *B. balanoides* in the nearby River Medway but again the species was restricted to the mouth of the estuary.

The related parasitic Rhizocephala are represented by *Sacculina carcini* which in the Thames is an occasional parasite of the shore crab *Carcinus maenas*.

(ii) Isopoda

Eight representatives of this order have been recorded in the tideway. *Asellus aquaticus*, associated normally with freshwater, is found occasionally in creeks and brackish sites in zone III. Below the Woolwich barrier site (II) the sea slater *Ligia oceanica* is common, being found amongst the stones and shingle around the high water mark and splash-zone.

Sphaeroma rugicauda and *Jaera albifrons* are found only where stones or rocks provide shelter. At Woolwich Ferry (III), for example, *S. rugicauda* is restricted to the lowest two or three stations as the mid-shore is muddy with few rocks, whereas two kilometres upriver at the new barrier site (II), specimens may be found throughout the more stony shore. *S. rugicauda* penetrates upriver to Greenwich (II) and *J. albifrons* downriver at least to Allhallows. Where overlap occurs at Greenhithe and Gravesend vertical separation up the shore is apparent, with *Jaera* extending more towards the high tide level. The numbers of both isopods have increased considerably since 1977. In that year at Greenhithe (IV), *S. rugicauda* and *J. albifrons* were found at only one and two stations respectively. By 1980 they were located at four and up to seven stations respectively, and *S. rugicauda* was found additionally at Gravesend (V). One specimen of the marine *S. monodi* was trawled at Shoeburyness (VII) in June 1977.

Idotea linearis, though rarely found above zone VI, is fairly common from this zone seaward, often associated with 'whiteweed'. Other species are *I. chelipes*, recorded from Greenhithe (IV) and Southend (VII) in August 1976, and Holehaven (VI) in July 1977 and *Cyanthura carinata* from the mud at Allhallows (VI) in September 1978.

(iii) Amphipoda

Several amphipod families are represented, many species being a major food source for both fish and birds.

The Gammaridae includes a succession of four species of *Gammarus* along the salinity gradient. *G. duebeni* is common under stones at the mid-to-upper shore level down to zone III. The normal range of *G. zaddachi* is from zones II to IV, mostly in the lower mid-shore, although it may extend into I and V if the salinity regime permits. In accordance with Nicol's (1968) findings, considerable overlap with *G. salinus* is observed, which is predominant in IV but commonly found in III-IV, generally below mid-tide level. *G. locusta* is restricted to zone VI outwards.

Melita palmata has been recorded in zone IV and seaward, especially on lower shore sites, but *M. obtusata* was only taken twice, in September 1976 from the Barrow Deep (VIII) and in September 1978 from Sea Reach (VII). *Chaetogammarus marinus* is fairly common, being found amongst fucoid fronds and under rocks as far upriver as Greenhithe (IV). Two species of 'strand-line' sand hoppers are found, *Orchestia gammarella* in zones II to V and *O. mediterranea*, which has a more seaward distribution, normally from IV outwards. One other talitrid *Hyale nilssoni*, has been identified from Cliffe (V) on three occasions. Otherwise it is fairly common in the outer estuary (VI-VIII).

The Corophiidae are represented by two species in the tideway, *Corophium volutator* which penetrates upriver to zone II and the less common *C. insidiosum*. *C. arenarium*, found extensively in previous surveys by Crawford (1937), Kay and Knights (1975) and Gee (1961) in the Leigh and Benfleet Creek areas (VI), has not been found during this present survey. In the Thames, Sedgwick (1979) and Page (1976) found *Corophium* to be heavily predated by flounder and sole and these amphipods are also extremely important in the diet of overwintering birds such as redshank (Goss-Custard *et al.* 1977).

Most of the other recorded amphipods are stenohaline marine organisms and were seldom taken due to the reduced sampling effort in the marine zone (VIII).

(iv) Mysidacea

Seven species of mysid shrimp were recorded, the commonest being *Neomysis integer*, which is found throughout the year as far upriver as zone II. It is often abundant and is a major food source for mid-water feeding fish (Sedgwick 1979

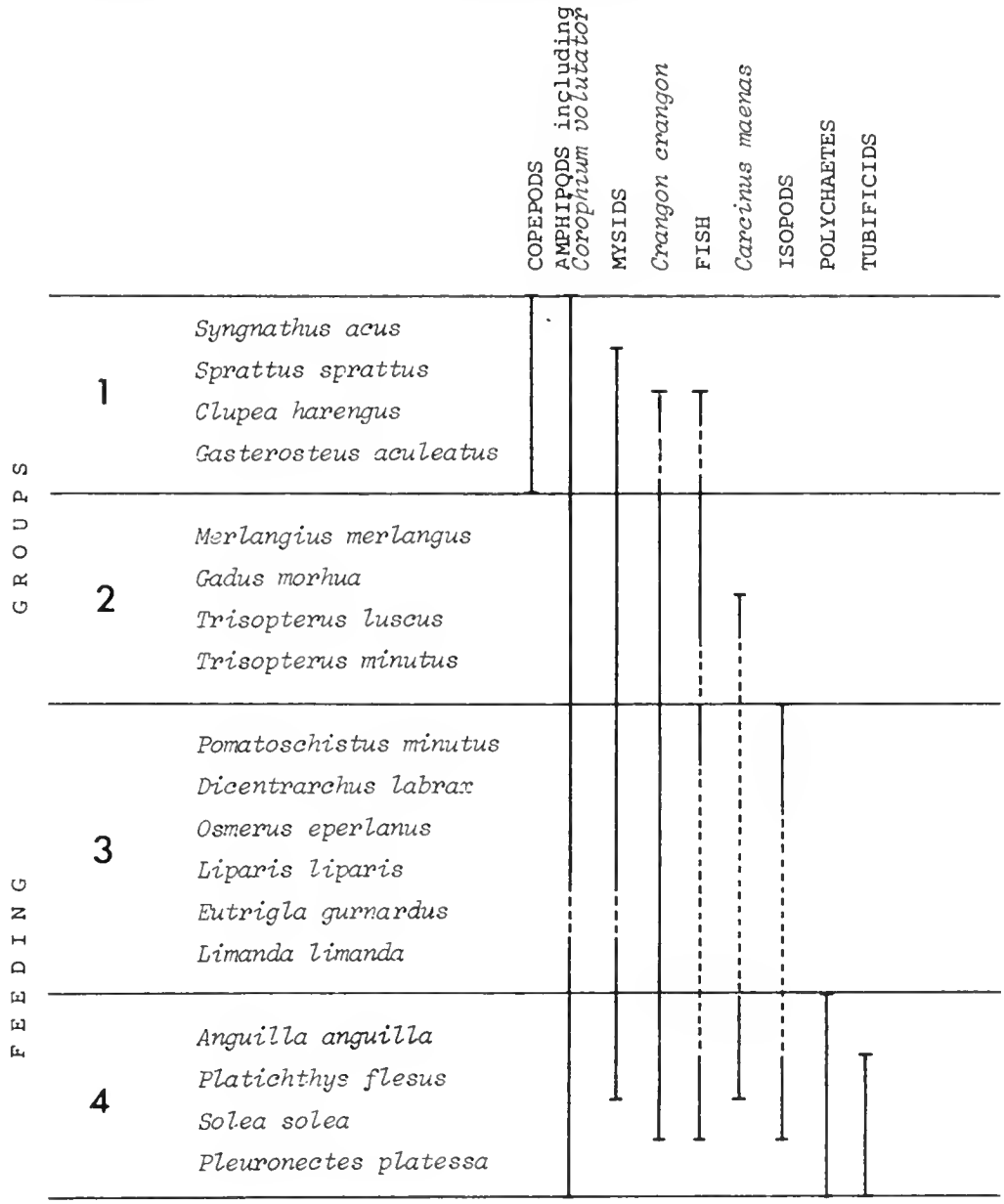
and Fig. 3). Other species are usually restricted to the outer estuary and marine zone (VII-VIII).

(v) Decapoda

The invertebrate caught in the greatest numbers both in trawls and especially at C.E.G.B. West Thurrock (IV) is the common shrimp, *Crangon crangon*, which is fished commercially in zones VII and VIII. In October 1974, MAFF (1975) surveys using a 12-foot beam trawl produced large catches in zones V and VI, with the highest numbers of 120 pints per hour being trawled from Grays (Thurrock).

In most estuaries, upriver migration of shrimps occurs in summer, suggested by Meyer-Waarden and Tiews (1957), Havinga (1930) and others as a feeding migration which is temperature dependent. By contrast, upriver migration in the

FIG. 3. Feeding groups of Thames fish determined by similarity in composition of the diet. Reproduced by permission of Dr R. Sedgwick, from Sedgwick (1979).



Thames, at least until 1981, occurred during late autumn, with peak numbers of 10,000 shrimps per hour being entrained on the screens at West Thurrock yet only a few hundred recorded in the summer. In 1981 however, this autumnal influx did not occur. Numbers were relatively constant throughout the year at West Thurrock and several were netted in July from freshwater above London Bridge (I). Boddeke (1976) suggested that the autumn migration observed in *C. crangon* is a movement to the warmer water normally found offshore and Sedgwick (1979) reasoned that likewise in the Thames the shrimps were encouraged to move upriver to the region of artifically elevated temperatures found in the middle reaches.

Sedgwick (1979) considered that the limit of upriver penetration of *C. crangon* to the West Thurrock area which he observed in 1970-1972 was governed by the low dissolved oxygen levels found further upriver. Huddart and Arthur (1971*a*) recorded large temporal fluctuations in numbers of shrimp caught at West Thurrock which they attributed to low oxygen levels causing seaward movement. However, since that time, dissolved oxygen levels in this region have increased markedly following extensions and improvements to the major sewage treatment works, and Andrews (1977) demonstrated that by 1976 it was low salinity and not reduced oxygen levels which limited upriver penetration for many fishes and invertebrates.

The incidence of egg-carrying shrimp caught at West Thurrock (IV) has greatly increased. Huddart and Arthur (1971*a*) recorded only one berried shrimp amongst over 42,000 collected between 1968 and 1970, whilst Sedgwick (1979) noted less than 10% gravid in May and June 1972. This figure has increased to over 80% during the study period.

Predation of shrimps is high and they are a major food item for a variety of fish species, particularly the juvenile gadoids which are also winter visitors. Sedgwick (1979) found pouting *Trisopterus luscus* to be the primary predator.

Of the palaemonids, *Palaemon longirostris* is the most widespread and abundant, having established itself as the dominant prawn in recent years, and found in zones II to VI. Berried females are now fairly common in late spring and early summer. Smaldon (1979), however, states that it is little known in the British Isles and descibes its distribution as sporadic. Other palaemonids are stenohaline marine animals and rare visitors to the middle tideway.

Pandalus montagui is common in zones VI to VIII and is usually present in IV and V in early autumn. It was fished as 'pink shrimp' before World War II from zones VII and VIII but virtually disappeared soon after (MAFF 1975). It was recorded at West Leigh Middle (VI) in 1974 (MAFF 1975) and the population has increased over the study period.

Processa canaliculata was trawled at Mucking (V) in October 1980.

The outer estuary at one time supported a thriving shellfish industry involving lobsters *Homarus gammarus*, squat lobsters *Galathea* spp. and crabs such as *Cancer pagurus, Pagurus bernhardus, Porcellana longicornis* and *Carcinus maenas*, some of which were sold as bait (Murie, MS). Many species have been virtually eliminated by the dumping of dredged material over their feeding grounds in the early part of this century.

The common shore crab *Carcinus maenas* is often abundant on rocky shores up to zone IV, is occasionally found in zone III and penetrated to Blackwall Point (II) during the drought of 1976 (Andrews 1977). The swimming crab *Macropipus holsatus* is present for much of the year in the outer estuary and enters the middle tideway for a few weeks in the summer, often in large numbers. Andrews (1977) reported 250 specimens taken in a six-hour screen sampling survey at C.E.G.B. West Thurrock (IV) in September 1976.

Seawater intrusion during the 1976 drought accounted for the occasional records of the velvet swimming crab *Macropipus puber* at West Thurrock (IV)

together with a few specimens of a spider crab *Macropodia longirostris* (Andrews 1977). These and all but one of the remaining crabs are normally restricted to zones VII and VIII although the hermit crab *Pagurus bernhardus* is occasionally also taken in zone VI.

Only two records in this country of the euryhaline Chinese mitten crab *Eriocheir sinensis* had been made until 1976 when three specimens were taken at West Thurrock (IV) (Ingle and Andrews 1976). Since then over twenty specimens have been recorded as detailed in Table 1, some penetrating as far upriver as Teddington (I), and the presence of berried females suggests a breeding population is becoming established in the Thames. Dr B. Barnett (personal communication) has informed us of specimens caught recently in the River Humber.

TABLE 1 Records of *Eriocheir sinensis* in the River Thames, 1976-1981.

Date	*Location*	*Sex*	*Comments*
February 1976	CEGB West Thurrock	M	Fragmented
May 1976	CEGB West Thurrock	M	Live
June 1976	CEGB West Thurrock	M	Live
August 1977	Teddington	M	Live. Caught on rod and line
July 1978	Teddington	M	Live. Caught on rod and line
January 1979	CEGB West Thurrock	F	Berried. Returned live to river
February 1979	CEGB West Thurrock	M	Live
April 1979	Regent's Canal dock entrance	F	Live
October 1979	Regent's Canal dock entrance		Twelve live crabs seen as canal level was lowered
December 1979	CEGB West Thurrock	F	Berried, live
December 1979	CEGB West Thurrock		Three returned live to river
August 1980	CEGB West Thurrock	M	Live
October 1980	CEGB West Thurrock	M	Live
April 1981	CEGB West Thurrock	M	Live
November 1981	CEGB West Thurrock	M	Live

MOLLUSCA

(i) Gastropoda

In the upper reaches of the estuary, nominal freshwater species are found occasionally, for example *Lymnaea peregra* has been recorded on three occasions living in zone III.

Potamopyrgus jenkinsi can survive in brackish water and is recorded regularly in zones I-III, often being abundant at the low water mark at Woolwich and Crossness (III) as well as in the freshwater tributaries in London (Aston and Andrews 1978). The first records of *P. jenkinsi* in this country were from the brackish River Thames, as described by Smith (1889). Jenkins (1891) considered *P. jenkinsi* to be the most abundant hydrobid in the Thames marshes in the 1880s, extending between Plumstead and Dartford (III). In the 19th century it was reported that pollution was causing several species of mollusc to retreat some miles downriver (Marshall 1889), amongst them *Assiminea grayana*. Although described by Macan (1977) as common in the Thames estuary, this species was not found at any site at the onset of this study. It was first recorded in Woolwich Reach (II) in October 1977, just upriver of the new flood barrier. Its range has since extended as the population increased and it has been found at Crossness (III), Grays (IV) and Greenhithe (IV). *Phytia myosotis* has been found at Dartford Creek (III/IV) in August 1977, and is much more limited in its distribution than at the time of Jenkins's (1891) surveys in the Thames.

Hydrobia ulvae is abundant on the flats at Blyth Sands (VI/VII), found occasionally at Cliffe (V) and has been recorded at Greenhithe (IV) once, in May 1977.

Littorina littorea is the most abundant littorinid in the estuary, is still collected commercially from rocky shores in zone VII and seaward, and was recorded as far

upriver as Greenhithe (IV) in 1979. *L. mariae* and *L. obtusata* (see Goodwin and Fish 1977 for recent revision of littorinid classification) are fairly common at Allhallows (VI) but only *L. obtusata* is found at Cliffe (V). *L. rudis* is found at Allhallows (VI).

Of the five nudibranchs recorded, *Acanthodoris pilosa* and *Archidoris pseudoargus* have been taken most frequently, particularly in outer estuary sites (VII-VIII) with *A. pilosa* being taken on two occasions upriver in zone V. The animals are found usually in association with the bryozoans *Alcyonidium* spp.

The slipper limpet *Crepidula fornicata*, which was introduced to this country in the 19th century with imported American oysters, is now fairly common in sublittoral habitats and is found on a variety of substrates from zone VI outward. Other marine gastropods were only recorded occasionally.

(ii) Bivalvia

Bivalve molluscs are represented by a few species; *Dreissena polymorpha* is found in the brackish zones II and III where it may constitute more than 20% cover particularly on wooden pilings at and below the low water mark. *Macoma balthica* is found at maximum densities of $1000m^{-2}$ at Cliffe (V) and $2000m^{-2}$ at Allhallows (VI). Kay and Knights (1975) reported this species in 89% of samples taken from the Blyth Sands area (VI). *Scrobicularia plana* is also present, occasionally at high densities (up to $700m^{-2}$ in December 1977 at Allhallows) in the intertidal mudflats.

Cerastoderma (Cardium) edule is infrequently found in shore and trawl surveys, but empty shells at Allhallows (VI) indicate a thriving community offshore. A decline in numbers followed the severe winter of 1962-63 (Crisp 1964) but the cockle is still fished commercially around Leigh and Southend (VII).

Very heavy mortalities (70-95%) of native oysters *Ostrea edulis* occurred on the Essex and Kent coasts in the winter of 1962-63 (Crisp 1964) and the species has not been recorded in our surveys. *Mytilus edulis* was unaffected by the cold and it is occasionally found on rocky shores and sublittorally upriver to zone V. Very dense colonies of mussels may be found on towers and pilings in the marine zone (VIII).

(iii) Cephalopoda

The two commonest cephalopods in the Thames, *Sepiola atlantica* and *Alloteuthis subulata*, are both occasional visitors and appear up to zone IV usually in the autumn. Three adult *Sepia officinalis* were taken at West Thurrock (IV) in September 1976.

ECHINODERMATA

Several echinoderms are found in the marine zone (VIII) including the common starfish *Asterias rubens*, the sea urchin *Psammechinus miliris* and the brittle stars *Ophiura texturata* and *Ophiothrix fragilis*. A 20-minute trawl in the Barrow Deep (VIII) in September 1976 collected 86 *A. rubens* and 116 *P. miliaris*, and 74 brittle stars were trawled in a 20-minute period in Outer Sea Reach (VII) one year later. A single sunstar *Crossaster paposus* was taken at the same location in September 1978.

CHORDATA

TUNICATA

Ascidacea

Molgula manhattensis is the only sea-squirt recorded in the tideway. Over 500 were taken at Stone Ness (IV) in a 10-minute trawl in May 1976 and large numbers penetrated to zone III later that year. This ascidian has only been taken occasionally since then, in zones IV-VI.

TABLE 2. List of invertebrate species found in the Thames estuary.

*indicates species recorded by other workers

	PHYLUM COELENTERATA	
	CLASS HYDROZOA	
Anthomedusae	Tubulariidae	*Tubularia indivisa* (L.)
		Cordylophora caspia Allman
Leptomedusae	Sertulariidae	*Sertularia argentea* L.
		Sertularia cupressina (L.)
	CLASS SCYPHOMEDUSAE	
Semaeostomae	Pelagiidae	*Chrysaora hysoscella* (L.)
	Aurcliidae	*Aurelia aurita* (L.)
	CLASS ANTHOZOA	
Alcyonacea	Alcyonidae	*Alcyonium digitatum* (L.)
Actinaria	Actiniidae	*Actinia equina* (L.)
	Metridiidae	*Metridium senile* (L.)
	PHYLUM CTENOPHORA	
	CLASS TENTACULATA	
	Pleurobrachiidae	*Pleurobrachia pileus* (O. F. Müller)
	CLASS NUDA	
	Beroidae	*Beroe cucumis* Fabricius
	PHYLUM NEMERTINI	
	CLASS ANOPLA	
Heteronemertini	Lineidae	*Lineus* sp.
	PHYLUM ANNELIDA	
	CLASS POLYCHAETAE	

Classification and nomenclature within this Class follow that of Hartman (1959, 1965)

Aphroditidae	*Aphrodita aculeata* L.
Polynoidae	*Lepidonotus squamatus* (L.)
	Malmgrenia castanea McIntosh
	Gattyana cirrosa (Pallas)
	Harmothoe impar (Johnston)
	Harmothoe extenuata (Grube)
Sigalionidae	*Pholoe minuta* (Fabricius)
	Sthenelais boa (Johnston)
Phyllodocidae	*Eteone flava* (Fabricius)
	Mysta picta (Quatrefages)
	Eumida sanguinea (Oersted)
	Notophyllum foliosum (Sars)
Syllidae	*Autolytus* sp.
	Eusyllis blomstrandi Malmgren
Nereidae	*Laeonereis glauca* (Claparède)
	Neanthes diversicolor (Müller)
	Neanthes succinea (Frey & Leuckart)
	**Neanthes virens* (Sars)
Nephtyidae	*Nephtys caeca* (Fabricius)
	Nephtys hombergii Savigny
	Nephtys longosetosa Oersted
Glyceridae	*Glycera ?convoluta* Keferstein
Goniadidae	*Goniada maculata* Oersted
Spionidae	*Streblospio* sp.
	Polydora ciliata (Johnston)
	Polydora flava Claparède
Cirratulidae	**Caulleriella zetlandica* (McIntosh)
	Cirratulus filiformis Keferstein
Flabelligeridae	*Flabelligera affinis* Sars
Capitellidae	*Capitella capitata* (Fabricius)
Arenicolidae	*Arenicola marina* (L.)
Sabellariidae	*Sabellaria spinulosa* Leuckart
Pectinariidae	*Lagis koreni* Malmgren
Terebellidae	*Amphitrite johnstoni* Malmgren
	Lanice conchilega (Pallas)

		Thelepus cincinnatus (Fabricius)
		Thelepus ?setosus (Quatrefages)
		Polycirrus aurantiacus Grube
	Sabellidae	*Sabella penicillus* L.
	Serpulidae	*Mercierella enigmatica* Fauvel
		Pomatoceros triqueter (L.)
	CLASS OLIGOCHAETAE	
	Tubificidae	*Peloscolex benedeni* (Udekem)
		Tubifex pseudogaster (Dahl)
		Tubifex costatus Claparède
		Tubifex tubifex (Müller)
		Limnodrilus hoffmeisteri Claparède
		Clitellio arenarius (Müller)
		Monopylephorus rubrinoveus (Levinsen)
		Monopylephorus irroratus (Verrill)
		Psammoryctides barbatus (Grube)
	Naididae	*Paranais litoralis* (Müller)
	Enchytraeidae	unidentified
	PHYLUM ARTHROPODA	
	SUBPHYLUM CRUSTACEA	
	CLASS COPEPODA	
Eucopepoda	Temoridae	*Eurytemora affinis* (Pope)
	CLASS CIRRIPEDIA	
Thoracica	Balanidae	*Balanus improvisus* Darwin
		Balanus balanoides (L.)
		Elminius modestus Darwin
Rhizocephala	Sacculinidae	*Sacculina carcini* Thompson
	CLASS MALACOSTRACA	
	SUBCLASS PERACARIDA	
Isopoda	Anthuridae	*Cyanthura carinata* (Krøyer)
	Limnoriidae	*Limnoria lignorum* (Rathke)
	Sphaeromatidae	*Sphaeroma rugicauda* Leach
		Sphaeroma monodi Bocquet
	Idoteidae	*Idotea linearis* (L.)
		Idotea chelipes (Pallas)
	Janiridae	*Jaera albifrons* grp. Leach
	Ligiidae	*Ligia oceanica* (L.)
	Asellidae	*Asellus aquaticus* (L.)
Amphipoda	Haustoriidae	*Bathyporeia elegans* Watkin
		Bathyporeia pelagica (Bate)
		Gammarus duebeni Liljeborg
		Gammarus salinus Spooner
		Gammarus locusta (L.)
		Gammarus zaddachi Sexton
		Melita palmata (Montagu)
		Melita obtusata (Montagu)
		Chaetogammarus marinus (Leach)
		Chaetogammarus obtusatus (Dahl)
	Talitridae	**Talitrus saltator* (Montagu)
		Orchestia gammarella (Pallas)
		Orchestia mediterranea A. Costa
		Hyale nilssoni (Bate)
	Corophidae	**Corophium arenarium* Crawford
		Corophium volutator (Pallas)
		Corophium insidiosum Crawford
	Aoridae	*Aora typica* (Krøyer)
	Atylidae	*Atylus guttatus* (Costa)
		Atylus falcatus Metzger
		Atylus vedlomensis (Bate & Westwood)
		Atylus swammerdami (Milne-Edwards)
	Stenothoidae	*Stenothoe marina* (Bate)
		Panoploea minuta (Sars)

	Calliopiidae	*Calliopius laeviusculus* (Krøyer)
		Perioculodes longimanus (Bate & Westwood)
	Caprellidae	*Caprella linearis* (L.)
Mysidacea	Mysidae	*Siriella armata* (Milne-Edwards)
		Gastrosaccus spinifer (Goes)
		Schistomysis spiritus (Norman)
		Schistomysis ornata (G. O. Sars)
		Praunus flexuosus (Müller)
		Mesopodopsis slabberi (Van Beneden)
		Neomysis integer (Leach)
Cumacea	Dyastylidae	*Dyastylis bradyi* Norman
	SUBCLASS EUCARIDA	
Euphausiacea	Euphausiidae	*Meganyctiphanes norvegica* (M. Sars)
		Nyctiphanes couchi (Bell)
Decapoda	Palaemonidae	*Palaemon adspersus* (Rathke)
		Palaemon elegans Rathke
		Palaemon serratus (Pennant)
		Palaemon longirostris Milne-Edwards
		Palaemonetes varians (Leach)
	Hippolytidae	*Hippolyte varians* Leach
		Thoralus cranchi (Leach)
	Processidae	*Processa canaliculata* Leach
	Pandalidae	*Pandalus montagui* Leach
		Pandalina brevirostris (Rathke)
	Crangonidae	*Crangon crangon* (L.)
		Philocheras trispinosus (Hailstone)
	Porcellanidae	*Porcellana longicornis* (L.)
	Paguridae	*Pagurus bernhardus* (L.)
		Pagurus pubescens (Krøyer)
	Maiidae	*Macropodia rostrata* (L.)
		Macropodia longirostris (Fabricius)
		Hyas arenarius (L.)
	Portunidae	*Carcinus maenas* (L.)
		Macropipus holsatus (Fabricius)
		Macropipus puber (L.)
	Cancridae	*Cancer pagurus* L.
	Xanthidae	*Pilumnus hirtellus* (L.)
	Pinnotheridae	*Pinnotheres pisum* (Pennant)
	Grapsidae	*Eriocheir sinensis* H. Milne-Edwards
	SUBPHYLUM PYCNOGONIDA	
	Pycnogonidae	*Pycnogonum littorale* (Strom)
	Nymphonidae	*Nymphon rubrum* Hodge
	Ammotheidae	*Achelia echinata* (Hodge)
	Phoxichilidiidae	*Anoplodactylus petiolatus* (Krøyer)
	SUBPHYLUM INSECTA	
	CLASS APTERYGOTA	
	Machilidae	*Petrobius* sp.

PHYLUM MOLLUSCA

	CLASS POLYPLACOPHORA	
	Lepidochitonidae	*Lepidochitona cinerea* (L.)
	Lepidopleuridae	*Lepidopleurus asellus* (Gmelin)
	CLASS GASTROPODA	
	SUBCLASS PROSOBRANCHIA	
Archeogastropoda	Patellidae	*Patella vulgata* L.
	Trochidae	*Gibbula cineraria* (L.)
		Gibbula umbilicalis (da Costa)

Mesogastropoda	Littorinidae	*Littorina mariae* Sacchi & Rastelli
		Littorina obtusata (L.)
		Littorina littorea (L.)
		Littorina rudis (Maton)
	Hydrobiidae	*Hydrobia ulvae* (Pennant)
		Potamopyrgus jenkinsi (Smith)
	Calypraeidae	*Crepidula fornicata* (L.)
Stenoglossa	Muricidae	*Nucella lapillus* (L.)
	Buccinidae	*Buccinium undatum* L.
		Urosalpinx conerea (Say)
	SUBCLASS OPISTHOBRANCHIA	
Nudibranchia	Onchidoridiidae	*Onchidoris bilamellata* (L.)
		Acanthodoris pilosa (Abilgaard)
	Archidoridiidae	*Archidoris pseudoargus* (Rapp)
	Facelinidae	*Facelina auriculata* (Müller)
	Aeolidiidae	*Aeolidia papillosa* (L.)
	SUBCLASS PULMONATA	
Basommatophora	Ellobiidae	*Phytia myosotis* (Drap.)
	Lymnaeidae	*Lymnaea peregra* (Müller)
		Lymnaea stagnalis (L.)
	Assimineidae	*Assiminea grayana* Fleming
	CLASS BIVALVIA	
	SUBCLASS PROTOBRANCHIA	
	Nuculidae	*Nucula sulcata* Bronn
	SUBCLASS LAMELLIBRANCHIA	
Dysodonta	Mytilidae	*Mytilus edulis* (L.)
		Modiolus modiolus (L.)
Eulamellibranchia	Cardiidae	*Cerastoderma edule* L.
	Veneridae	**Venerupis pullastra* (Montagu)
	Scrobiculariidae	*Scrobicularia plana* (da Costa)
	Tellinidae	*Macoma balthica* (L.)
	Teredinidae	**Teredo navalis* L.
	Petricolidae	*Petricola pholadiformis* Lamarck
		Dreissena polymorpha (Pallas)
	CLASS CEPHALOPODA	
Decapoda	Sepiidae	*Sepia officinalis* (L.)
	Sepiolidae	*Sepiola atlantica* (d'Orbigny)
		Alloteuthis subulata (Lamarck)
	PHYLUM BRYOZOA	
	CLASS GYMNOLAEMATA	
Ctenostomata	Alcyonidiidae	*Alcyonidium gelatinosum* (L.)
		Alcyonidium hirsutum (Fleming)
Cheilostomata	Flustridae	*Flustra foliacea* (L.)
	PHYLUM ECHINODERMATA	
	CLASS ASTEROIDEA	
Forcipulata	Asteriidea	*Asterias rubens* L.
Spinulosa	Solasteridae	*Crossaster papposus* (L)
	CLASS OPHIUROIDEA	
Ophiurae	Ophiotrichidae	*Ophiothrix fragilis* (Abildgaard)
	Ophiuridae	*Ophiura ?texturata* Lamarck
	CLASS ECHINOIDEA	
Diadematoidea	Echinidae	*Psammechinus miliaris* P. L. S. Müller
	PHYLUM CHORDATA	
	SUBPHYLUM TUNICATA	
	CLASS ASCIDIACEA	
Peurogona	Molgulidae	*Molgula manhattensis* (De Kay)

SECTION II — FISHES FOUND IN THE THAMES ESTUARY

PETROMYZONIFORMES
Petromyzonidae

The lamprey *Petromyzon marinus* and lampern *Lampetra fluviatilis* have been recorded infrequently in the estuary. The lampern appears more commonly, nine having been taken at West Thurrock.

LAMNIFORMES and RAJIFORMES

The roker or thornback ray *Raja clavata* has been taken on two occasions during our survey. Records of other species are those of other authors (Table 3).

ANGUILLIFORMES
Anguillidae and Congridae

The eel *Anguilla anguilla* is found commonly throughout the estuary. A peak count of 71 adult fish in two hours was recorded at West Thurrock power station in October 1976. An upriver migration of elvers occurs during the spring and by June they may be found throughout the tidal Thames and its tributaries.

The conger *Conger conger* was recorded during the survey on only five occasions. A 30kg specimen was taken at Erith (III) in December 1977 and one of about 15kg was caught at West Thurrock power station in October 1975.

CLUPEIFORMES
Clupeidae

Forty-one anchovy *Engraulis encrasicolus* were taken in the estuary during the drought conditions of 1975 and 1976. Since then only three further specimen have been noted (October 1978, May 1979, December 1981).

O-group and 1+ sprat *Sprattus sprattus* and herring *Clupea harengus*, collectively known as whitebait, are common in the estuary. Their fluctuating abundance is associated both with seasonal migrations and with the level of spawning success each year in the southern North Sea. Numbers of sprat declined during the survey period until the successful spawnings of 1979-80 when postlarvae were trawled in their hundreds over the Blyth sands (VI) in June. Catches at West Thurrock are dominated by 1+ fish of total body length 60-80mm and so it was not until 1981 that large numbers were again observed on the screens, 1500 sprat being caught in one hour's sampling during January.

Herring abundance has increased significantly over the survey period. Peak counts per 100 million gallons of cooling water at West Thurrock power station were 30 in February 1977, 368 in January 1978, 2420 in December 1978 and 3719 in February 1980. Since 1980 herring have been present throughout the year at West Thurrock, whereas previously they were not found in the warmer months. Investigation of vertebral and keel scale counts by scientists from the Ministry of Agriculture, Fisheries and Food indicate that Thurrock fish were of the spring spawning Thames stock (J. Riley, personal communication).

SALMONIFORMES
Salmonidae

The several records for salmon *Salmo salar* from the estuary are given in Table 3*. Those fish taken in July 1975 and October 1980 were in an advanced state of decay. The smolts found in the estuary were in all probability fish introduced

*See Postscript on p.62.

previously by Thames Water Authority staff into selected nursery streams. Regular stocking into Thames tributaries has been undertaken since the commencement of a restoration programme which in its first phase aims to produce a downstream run of 20,000 smolts each year. In the period 1978-81 approximately 160,000 fry, parr, and smolt-stage fish were introduced.

Table 3 does not include records of salmon parr captures (e.g. Richmond (I) 6 and 8 October '79) nor of the five adult fish which were taken from the non-tidal Thames at Shepperton 5 September '78; Chertsey 5 January '81; Caversham 21 August '81; Sunbury 23 August '81; Hampton 6 September '81.

Twelve sea trout *Salmo trutta* were recorded by Thames Water Authority fisheries staff from the tidal part of the river in the study period. Further captures were made in London dock systems and from the non-tidal river above Teddington. A female sea trout kelt found in the River Colne in January 1981 provided the first positive indication of a migratory salmonid spawning in the Thames watershed this century.

The rainbow trout *Salmo gairdneri* is becoming increasingly more common in the estuary. Information given in Table 1 for records below London Bridge supplements the 'downriver' records for this species given by Wheeler (1979).

Osmeridae

The smelt *Osmerus eperlanus* is now found throughout the river. In 1977 this species became abundant in the middle estuary (II-IV). Annual peak counts per 100 million gallons of cooling water used at West Thurrock were 3 (1974), 14 (1975), 44 (1976), 972 (1977), 1029 (1978) and 2484 (1979). Gravid females are taken during the spring and summer months; even small fish (80-140mm) are found to be gravid from February through April. Several hermaphrodite smelt within the size class have been reported from the Thames (P. Hutchinson, personal communication).

CYPRINIFORMES

Cyprinidae

Records from the Thames Angling Preservation Society suggest that dace *Leuciscus leuciscus* and bleak *Alburnus alburnus* are the most common fish in the inner estuary (I).

The gudgeon *Gobio gobio* is often collected during seine netting in the inner reaches (I).

Downriver penetration of cyprinids occurs at times of high freshwater flow, such as during the winter of 1974/75. At that time bleak, tench *Tinca tinca*, roach *Rutilus rutilus*, bream *Abramis brama*, goldfish *Carassius auratus* and crucian carp *C. carassius* were taken in zones III and IV.

LOPHIIFORMES

Lophiidae

Ten dead and one live specimens of anglers *Lophius piscatorius* have been found in the estuary. It is possible that all had been living in the tideway although it is usually associated with open sea coasts.

GADIFORMES
Gadidae

This family contains the fishes that make up the bulk of the pelagic estuarine fauna during the winter months.

Whiting *Merlangius merlangus* can be extremely abundant in late autumn and winter. A total of 3349 fish were taken in two hours' sampling at West Thurrock in January 1976 and 5043 were recorded in one hour at that location in October 1977. Events outside the Thames such as spawning success determines the abundance of this fish in the estuary.

Bib or pouting *Trisopterus luscus* and poor cod *Trisopterus minutus* are also seasonally common in the estuary. Cod *Gadus morhua* is frequently taken by anglers in zones V-VII and it often forms a large proportion of the catch at the City of London Fishery Experiment which takes place at Gravesend (V) in spring.

Both haddock *Melanogrammus aeglefinus* and pollack *Pollachius pollachius* enter the river infrequently. Following the appearance of haddock in 1966 and 1969-1971 (Wheeler 1979) there were no records from the tideway until the winters of 1979-80 and 1980-81 when it was collected at several locations. Similarly the occurrence of pollack in 1978 and 1979 were the first reports from the tideway since 1971 when it was reported by Wheeler (1979).

Five species of rockling have been recorded during the survey. Only the five-bearded rockling *Ciliata mustela* is common, and during the drought conditions in February 1976 penetrated to zone II.

ATHERINIFORMES
Atherinidae

Only five sand-smelt *Atherina presbyter* have been recorded in the estuary. This contrasts markedly with records from the River Medway, which joins the Thames in zone VII, where sand smelt was often the dominant species (Van den Broek 1979).

GASTEROSTEIFORMES
Gasterosteidae

The three-spined stickleback *Gasterosteus aculeatus* is ubiquitous in the middle and inner estuary and in the freshwater tributaries and marshland ditches from which there may be substantial recruitment, especially during times of high rainfall.

Syngnathidae

Of the four species of pipefish found in the estuary, Nilsson's pipefish *Syngnathus rostellatus* and the greater pipefish *Syngnathus acus* are the most common. Both are taken at West Thurrock in autumn and spring and in addition *S. rostellatus* may be present during winter and occasionally in summer. The brood pouch of males may be full of developing eggs in May and June. *S. acus* regularly penetrates further upriver to zone II. We recorded one seahorse *Hippocampus ramulosus* from Ford's Power Services screens at Dagenham (III) in October 1976.

SCORPAENIFORMES

Triglidae

The tub gurnard *Trigla lucerna* has been recorded on many occasions throughout the year but usually in low numbers. The red gurnard *Aspitrigla cuculus* and the grey gurnard *Eutrigla gurnardus*, however are only occasionally recorded in the tideway.

Cyclopteridae

Six lumpsuckers *Cyclopterus lumpus* have been recorded during our survey, including on 13 November 1980, two juveniles, each 55mm total length, at West Thurrock.

Percichthyidae

The bass *Dicentrarchus labrax* is a regular visitor to the middle estuary from late summer to early spring, penetrating to zone II. Occasionally, shoals of juveniles (1+ fish) are recorded. In a 90 minute survey at Ford's Power Services screens, Dagenham (III) in September 1976, 170 were taken.

PERCIFORMES

Percidae

The perch *Perca fluviatilis* is common in the inner estuary (I) but is also recorded occasionally in the more saline reaches (II-IV), particularly after heavy rainfall.

Ammodytidae

Three species of sandeel have been recorded in the estuary. The sandeel *Ammodytes tobianus* was taken in five out of the seven years of the survey, the peak year for this species being 1977, when 23 were taken at West Thurrock (IV). Raitt's sandeel *A. marinus*, usually regarded as an offshore species, penetrated further upriver in 1976, especially during the first two months when several were taken at Blackwall Point (II). The greater sandeel *Hyperoplus lanceolatus* was most frequently taken in spring and early summer, and was found each year except for 1975 and 1979.

Trachinidae

The lesser weever *Echiichthys vipera* was taken at West Thurrock on several occasions, especially during the drought conditions of 1976. A. L. Wells (undated) listed the greater weever *Trachinus draco* as being common in the estuary during the last century but this species has not been found in the Thames during our survey.

Gobiidae

The sand goby *Pomatoschistus minutus* is the most abundant goby in the estuary, being present all the year round, and has been found from zones I to VII. It is an important component in the estuarine food web, being preyed upon particularly by flounder, the larger gadoids, herring and bass. A peak count of 2100 fish was recorded in one hour's sampling at West Thurrock in October 1976 at which time upriver penetration to Battersea (I) was reported by Andrews (1977).

The common goby *Pomatoschistus microps* is less abundant and less widespread than the sand goby, usually being restricted to zones I-IV and with trawl catches normally containing less than 10 individuals. The abundance peak occurs at West Thurrock in August and September.

The rock goby *Gobius paganellus* was recorded on five occasions between 1975-1977, firstly in Sea Reach (VI) and subsequently at West Thurrock. This species is normally confined to rocky shores of the South and West coasts of England.

Mugilidae

The thick-lipped grey mullet *Chelon labrosus* is found in the middle and outer estuary in late summer when shoals of adult fish are often seen. In November 1976 several fish resided in the effluent channel of Beckton Sewage Treatment Works (III). During the autumn and winter period thin-lipped grey mullet *Liza ramada*, many of which are only 100-200mm in length, are caught on the cooling water screens at West Thurrock. Of the 472 recorded, 79% were taken at one sampling occasion, on 30 December 1981.

PLEURONECTIFORMES

Pleuronectidae

The flounder *Platichthys flesus* is found throughout the estuary. Upriver migration of the O-group fish (some less than 20mm total length) to zone I is completed by June each year. Large numbers may be taken with a hand net at this time in the freshwater reaches. Large populations also occur in the mud reaches of zone III where the fish remain for up to two years. A 10-minute trawl at Barking (III) in August 1978 collected more than 2500 mainly O-group flounders. Autumn and spring abundance peaks of adults at West Thurrock probably reflect migrations to and from spawning areas at the mouth of the estuary.

The plaice *Pleuronectes platessa* is common in zones VI-VIII and is commercially fished in the outer estuary. Young plaice have been taken at West Thurrock, especially during the autumn.

A third member of this family, the dab *Limanda limanda*, is also common in zones VI-VIII. O-group and 1+ fish are frequently found at West Thurrock in autumn and winter. The number of dabs recorded in trawls and power station surveys during 1980/81 shows a considerable increase over previous years.

Soleidae

The Dover sole *Solea solea* may be found as far upriver as zone II, but is only abundant from zone IV seawards. Zones V and VI have been identified as major spawning and nursery grounds for this species (Riley 1973). Large numbers of O-group and 1+ fish are frequently trawled in the Tilbury area (V): 340 soles were taken in eight minutes in October 1979 and 362 in ten minutes in October 1981.

TETRAODONTIFORMES

Balistidae and Molidae

Three trigger-fish *Balistes carolinensis* and a sunfish *Mola mola* have been recorded from the tideway. Both species are regarded as unexpected and rare in this area (Wheeler 1969).

TABLE 3 List of fishes from the Thames estuary with abundance and distribution information. Arranged according to Wheeler (1978)
*Recorded by other workers
#Maximum number recorded on any one sampling visit (excluding 24-hour survey on 2/3 October 1978)

FAMILY Species	Zones Recorded	CEGB West Thurrock (W.Th.) 1975-1981 Total Count	 Peak Count#	Notes (W.Th. dates not given where total count exceeds 7)
PETROMYZONIFORMES				
PETROMYZONIDAE				
Lamprey *Petromyzon marinus*	II-IV	1	1	W.Th. (IV) Apr. '80; Royal Docks (II) 3 June '78; Barking (III) 30 Oct. '74.
Lampern *Lampetra fluviatilis*	IV-V	8	2 (18 July '77)	Tilbury (V) 7 Apr. '81
LAMNIFORMES				
SCYLIORHINIDAE				
Dogfish *Scyliorhinus canicula*	VI-VII	0	0	E. Blyth (VI) 7 May '81; Nore Swatch (VII) May '78 (J. Riley, personal communication)
TRIAKIDAE				
*Starry smooth hound *Mustelus asterias*	IV	0	0	(Wheeler 1979)
RAJIFORMES				
RAJIDAE				
Roker *Raja clavata*	VI-VII	0	0	Blyth sands (VI) 17 June '76 (2 specimens); The Cant (VII) 8 Sept. '77
DASYATIDAE				
*Stingray *Dasyatis pastinaca*	IV	0	0	(Wheeler 1979)
ACIPENSERIFORMES				
ACIPENSERIDAE				
*Sturgeon *Acipenser sturio*	VIII	0	0	(Wheeler 1979)

ANGUILLIFORMES				
ANGUILLIDAE				
Eel *Anguilla anguilla*	I-V	1836	91 (28 Oct. '76)	
CONGRIDAE				
Conger *Conger conger*	II-VI	3	1	W.Th. (IV) Feb. '75, Oct. '75, Nov. '77; Blackwall Point (II) Dec. '76; Erith (III) 3 Dec. '77
CLUPEIFORMES				
CLUPEIDAE				
Anchovy *Engraulis encrasicolus*	II-IV	41	13 (26 Nov. '76)	Brunswick Wharf (II) Feb '76 (3 fish); Barking (III) 11 Nov. '75
Allis shad *Alosa alosa*	I-IV	2	1	W.Th. (IV) Sep. '75, 15 July '76; Blackwall Point (II) Feb. '76; Richmond (I) 29 Sep. '77
Twaite shad *A. fallax*	II-IV	5	1	W.Th. (IV) Oct. '75 (2 specimens), Nov. '75, Oct. '77, Nov. '77; Blackwall Point (II) Jan. '76
Pilchard *Sardina pilchardus*	IV	0	0	W.Th. (IV) 11 Dec. '74; Reported as common in the outer estuary (VIII) by A. L. Wells (undated)
Sprat *Sprattus sprattus*	I-VIII	17424	3005 (23 Jan. '81)	Battersea (I) Sep. '76; otherwise II-VIII
Herring *Clupea harengus*	II-VIII	34370	3719 (7 Feb. '80)	
SALMONIFORMES				
THYMALLIDAE				
Grayling *Thymallus thymallus*	II	0	0	Blackwall Point (II) Mar. '75
SALMONIDAE				
†Salmon *Salmo salar*	I-VII	4	1	W.Th. (IV) 12 Nov. '74, 26 Apr. '78 (smolt), 18 May '80, 14 Apr. '81 (smolt), 4 June '81 (smolt); Twickenham (I) 1 Sep. '81; Brentford (I) 3 Aug. '79; City of London (I) 3 Oct. '80; Wapping (II) 7 Aug. '81; Greenwich (II) 31 July '81; Brunswick Wharf (II) 18 Apr. '78 (smolt), 19 May '81 (smolt); Dagenham (III) 14 July '75; Tilbury (V) 12 Sep. '80, 18 May '81 (2 smolt); Westcliff Flats (VII) 18 Aug. '80
Trout *S. trutta*	I-V	1	1	W.Th. (IV) Jan. '79; 12 further records in tideway
Rainbow trout *S. gairdneri*	I-VII	2	1	W.Th. (IV) 12 June '79, 28 Aug. '80; Wapping (II) 1 Aug. '81 (2 fish); Crossness (III) 3 Aug. '81 (3 fish); Purfleet (IV) 11 Sep. '79 (2 fish); Gravesend (V) 21 July '77; Tilbury (V) 18 May '81, 15 July '81; Southend (VII) 15 May '81

†See Postscript on p.62.

CEGB West Thurrock (W.Th.) 1975-1981

ORDER FAMILY Species	Zones Recorded	Total Count	Peak Count#	Notes (W.Th. dates not given where total count exceeds 7)
OSMERIDAE				
Smelt *Osmerus eperlanus*	I-VII	35657	2484 (21 Nov. '79)	
ESOCIDAE				
Pike *Esox lucius*	I-II	0	0	Blackwall Point (II) Oct. '77, Jan. '78; Woolwich (II) 19 Jan. '78; Brunswick Wharf (II) 18 Dec. '79; Common in the Royal Docks (II)
CYPRINIFORMES				
CYPRINIDAE				
Carp *Cyprinus carpio*	I,IV	1	1	W.Th. (IV) 15 Oct. '81
Barbel *Barbus barbus*	I	0	0	Richmond (I) May '76
Gudgeon *Gobio gobio*	I	0	0	Regularly taken by seine net
Tench *Tinca tinca*	I-III	0	0	Ford's, Dagenham (III) Nov. '74, 7 Jan. '77
Crucian carp *Carassius carassius*	I-IV	0	0	W.Th. (IV) Nov. '74, Dec. '74; Ford's Dagenham (III) Nov. '74, Feb. '75 (2 fish)
Goldfish *C. auratus*	I-III	0	0	Barking (III) Jan. '75
Bleak *Alburnus alburnus*	I-III	0	0	Blackwall Point (II) May '76, Dec. '77; Ford's Dagenham (III) Nov. '74, Jan. '75
Bream *Abramis brama*	I-IV	1	1	W.Th. (IV) 9 Mar. '77
Minnow *Phoxinus phoxinus*	I	0	0	Taken by seine net
Rudd *Scardinius erythrophthalmus*	I-II	0	0	Tower Bridge (II) 10 Mar. '77; Brunswick Wharf (II) 7 Dec. '76, 4 May '77
Roach *Rutilus rutilus*	I-IV	3	1	W.Th. (IV) 15 Nov. '74, 22 Feb. '77, 10 May '78, 27 Oct. '80
Chub *Leuciscus cephalus*	I-II	0	0	Brunswick Wharf (II) Apr. '77
Dace *L. leuciscus*	I-III	0	0	Rotherhithe (II) 29 Dec. '77; Blackwall Point (II) June '79; Barking (III) 1 Feb. '79, 8 Feb. '79
COBITIDAE				
Stone loach *Noemacheilus barbatulus*	I	0	0	
LOPHIIFORMES				
LOPHIIDAE				
Angler *Lophius piscatorius*	III-V	0	0	Tilbury (V) 14 July '75 alive. Ten further fish stranded on shores between III-V

GADIFORMES				
GADIDAE				
Blue whiting *Micromesistius poutassou*	II-IV	8	1	Brunswick Wharf (II) Oct. '79
Whiting *Merlangius merlangus*	II-VIII	54944	6439 (29 Sep. '77)	
Bib *Trisopterus luscus*	II-VII	4916	822 (17 Oct. '77)	
Poor cod *T. minutus*	II-VI	1469	100 (7 Feb '80)	
Pollack *Pollachius pollachius*	IV	4	1	W.Th. (IV) 13 Jan. '78, Dec. '78, 25 July '79, 15 Oct. '81
Cod *Gadus morhua*	III-VII	382	45 (9 Nov. '79)	
Haddock *Melanogrammus aeglefinus*	II-IV	5	1	W.Th. (IV) 11 Dec. '79, Feb. '80, Jan. '81 (2 fish), 23 Jan. '81; Brunswick Wharf (II) Jan. '81; Woolwich (III) 20 Jan. '81.
Tadpole-fish *Raniceps raninus*	II-IV	19	4 (25 Nov. '80)	Brunswick Wharf (II) Feb. '76, Nov. '78; Blackwall Point (II) Nov. '79
Shore rockling *Gaidropsarus mediterraneus*	IV	1	1	W.Th. (IV) 30 Jan. '78
Three-bearded rockling *G. vulgaris*	IV	1	1	W.Th. (IV) 24 Mar. '76
Four-bearded rockling *Enchelyopus cimbrius*	IV	0	0	W.Th. (IV) 15 Nov. '74
Five-bearded rockling *Ciliata mustela*	II-VI	34	3 (16 Nov. '81)	Brunswick Wharf (II) Feb. '76; Gravesend (V) 27 Mar. '76; Mucking (V) 22 Nov. '79; E. Blyth (VI) 13 Feb. '81
Northern rockling *C. septentrionalis*	II-IV	2	1	W.Th. (IV) 22 Feb. '77, 21 Feb. '80; Barking (III) Jan. '75
ZOARCIDAE				
*Viviparous blenny *Zoarces viviparus*	VI	0	0	Leigh-on-Sea (VI) Apr. '77 (Wheeler 1979)
ATHERINIFORMES				
ATHERINIDAE				
Sand-smelt *Atherina presbyter*	III-IV	4	1	W.Th. (IV) Oct. '75, 26 Nov. '76, 10 Jan. '77, 20 June '77; Ford's Dagenham (III) 10 Dec. '76
BELONIDAE				
Garfish *Belone belone*	II,VIII	0	0	Off Royal Docks (II) July '76; Spaniard Buoy (VIII) 13 May '81
SCOMBERESOCIDAE				
*Skipper *Scomberesox saurus*	IV	0	0	(Wheeler 1979)

ORDER FAMILY Species	Zones Recorded	CEGB West Thurrock (W.Th.) 1975-1981 Total Count	Peak Count#	Notes (W.Th. dates not given where total count exceeds 7)
ZEIFORMES				
ZEIDAE				
Dory *Zeus faber*	II-IV	8	1	W.Th. (IV) 5 specimens during Nov. '77; Woolwich (II) Dec. '77
GASTEROSTEIFORMES				
GASTEROSTEIDAE				
Three-spined stickleback *Gasterosteus aculeatus*	I-V	999	69 (29 Mar. '79)	
Nine-spined stickleback *Pungitius pungitius*	III	0	0	Ford's Dagenham (III) 27 Oct. '75, 24 Nov. '75 (2 specimens), 31 Mar. '76; Mardyke (III) 22 Nov. '79
SYNGNATHIDAE				
Deep-snouted pipefish *Syngnathus typhle*	IV	3	1	W.Th. (IV) 15 Nov. '74, 14 Aug. '77, 20 Mar. '80, 9 Feb. '81
Greater pipefish *S. acus*	II-VII	149	41 (29 Mar. '78)	
Nilsson's pipefish *S. rostellatus*	III-VI	1293	213 (19 May '80)	Not recorded upriver of IV since 1976
Worm pipefish *Nerophis lumbriciformis*	IV	1	1	W.Th. (IV) 30 Dec. '77
Sea-horse *Hippocampus ramulosus*	III	0	0	Ford's, Dagenham (III) 11 Oct. '76
SCORPAENIFORMES				
TRIGLIDAE				
Grey gurnard *Eutrigla gurnardus*	IV	10	2 (13 Jan. '78)	
Red gurnard *Aspitrigla cuculus*	III-IV	34	3 (12 Oct. '76)	W.Th. (IV) 9 during 24 hr. survey 2/3 Oct. '78; Barking (III) 30 Oct. '74; Ford's, Dagenham (III) Oct. '76, Nov. '76
Tub gurnard *Trigla lucerna*	II-IV	261	14 (21 Nov. '79)	W.Th. (IV) 15 Nov. '74 (28 specimens)
COTTIDAE				
Bull-rout *Myoxocephalus scorpius*	IV	1	1	W.Th. (IV) 17 Oct. '77
Sea scorpion *Taurulus bubalis*	IV,VI	2	1	W.Th. (IV) 30 Nov. '77, Aug. '80; Chapman Sands (VI) 4 Aug. '80
Bullhead *Cottus gobio*	I	0	0	Near confluence of River Crane (I)

AGONIDAE				
Hooknose *Agonus cataphractus*	II-VIII	918	179 (13 Jan. '78)	Common in zones IV-VI in all but the summer months
CYCLOPTERIDAE				
Lumpsucker *Cyclopterus lumpus*	IV-V	6	2 (13 Nov. '80)	W.Th. (IV) Feb. '75, Apr. '78, 13 Nov. '80 (2 specimens), 23 Jan. '81, 25 Mar. '81; Tilbury (V) 3 Feb. '81, 5 Feb. '81
Sea-snail *Liparis liparis*	II-VIII	1019	181 (13 Jan. '78)	Brunswick Wharf (II) Feb. '76, 3 Jan. '80; Blackwall Point (II) Feb. '76, Dec. '79; Ford's, Dagenham (III) Jan. '76
Montagu's sea-snail *L. montagui*	IV	11	4 (13 Nov. '80)	
PERICICHTHYIDAE				
Bass *Dicentrarchus labrax*	I-VIII	1871	262 (26 Nov. '76)	Ford's, Dagenham (III) Sep. '76 (170 juveniles in a 90 minute sample).
PERCIFORMES				
PERCIDAE				
Ruffe *Gymnocephalus cernuus*	I-III	0	0	Ford's, Dagenham (III) Nov. '74; Brunswick Wharf (II) Apr. '80, 19 May '81
Perch *Perca fluviatilis*	I-IV	14	6 (31 July '80)	The 6 fish in the peak count were all 40-60mm long. Usually fish of 100-250mm are taken.
CARANGIDAE				
Scad *Trachurus trachurus*	II-VII	35	3 (28 Oct. '75)	Blackwall Point (II) Oct. '76; Brunswick Wharf (II) Oct. '78; Ford's, Dagenham (III) Oct. '75, 20 May '77; Otherwise all records from W.Th. (IV); The Cant (VII) 7 Sep. '78
MULLIDAE				
Red mullet *Mullus surmuletus*	III-IV	12	2 (13 Sep. '76)	Ford's, Dagenham (III) Oct. and Nov. '76
SPARIDAE				
Black sea-bream *Spondyliosoma cantharus*	IV	3	1	W.Th. (IV) Sep. '75, Nov. '77, 2 Oct. '78
LABRIDAE				
Ballan wrasse *Labrus bergylta*	IV-V	0	0	Northfleet (IV) 7 Jan. '75; Tilbury (V) 25 Apr. '79

ORDER FAMILY Species	Zones Recorded	CEGB West Thurrock (W.Th.) 1975-1981 Total Count	Peak Count#	Notes (W.Th. dates not given where total count exceeds 7)
AMMODYTIDAE				
Sandeel *Ammodytes tobianus*	II-IV	36	10 (10 July '77)	
Raitt's sandeel *A. marinus*	II-IV	17	4 (15 Dec. '81)	Blackwall Point (II) 14 taken in Jan. '76
Greater sandeel *Hyperoplus lanceolatus*	IV	20	2 (3 occasions)	Usually in late spring and early summer
TRACHINIDAE				
Lesser weever *Echiichthys vipera*	IV-VIII	12	1	6 fish trawled from Knock John Channel (VIII) on 30 Sep. '76
SCOMBRIDAE				
Mackerel *Scomber scombrus*	II-IV	8	1	Barking (III) 30 Oct. '74, Nov. '74 (2 specimens); Brunswick Wharf (II) Feb. '76; Blackwall Point (II) Nov. '79
GOBIIDAE				
Transparent goby *Aphia minuta*	III-VII	34	8 (9 Mar. '77)	
Common goby *Pomatoschistus microps*	I-VI	254	74 (5 Sep. '78)	
Sand goby *P. minutus*	I-VII	47928	2978 (13 Dec. '76)	
*'Sand' goby *P. lozanoi*	VI-VII	0	0	(Wheeler 1979)
*Leopard-spotted goby *Thorogobius ephippiatus*	IV	0	0	W.Th. (IV) 1972 (Sedgwick 1979)
Black goby *Gobius niger*	IV-VI	57	5 (13 Aug. '76)	
Rock goby *G. paganellus*	IV-VI	4	2 (21 Jan. '76)	W.Th. (IV) 26 Sep. '75, 21 Jan. '76 (2 specicmens) 15 Nov. '77; Sea Reach (VI) 12 Sep. '75
CALLIONYMIDAE				
Dragonet *Callionymus lyra*	IV-VIII	88	15 (16 Sep. '77)	Breeding males, reported absent by Huddart and Arthur (1971*b*) are now found.

PHOLIDAE				
Butterfish *Pholis gunnellus*	IV	2	1	W.Th. (IV) 15 Nov. '77, 28 Aug. '79
MUGILIDAE				
Thick-lipped grey mullet *Chelon labrosus*	III-VI	28	6 (13 Dec. '76)	W.Th. (IV) 2/3 Oct. '78 (7 specimens during a 24 hour survey); Beckton (III) Nov. '76
Thin-lipped grey mullet *Liza ramada*	III-V	472	371 (30 Dec. '81)	Ford's, Dagenham (III) Feb. '77
PLEURONECTIFORMES				
SCOPHTHALMIDAE				
Brill *Scophthalmus rhombus*	II-VIII	13	3 (21 Nov. '79)	Brunswick Wharf (II) 7 Oct. '78; Woolwich (III) 13 Dec. '79; E. Blyth (VI) 29 Aug. '79; Barrow (VIII) 24 Apr. '80
BOTHIDAE				
Scaldfish *Arnoglossus laterna*	II,IV	1	1	W.Th. (IV) 29 Mar. '78; Blackwall Point (II) Jan. '76
PLEURONECTIDAE				
Dab *Limanda limanda*	III-VIII	1543	210 (25 Nov. '80)	Mardyke (III) 27 Sep. '79
Flounder *Platichthys flesus*	I-VIII	44540	4648 (31Aug. '77)	
Plaice *Pleuronectes platessa*	III-VIII	662	54 (29 Sep. '77)	
Lemon sole *Microstomus kitt*	IV-VIII	7	2 (13 Nov. '80)	W.Th. (IV) Feb. '77, 17 Oct. '77, 22 Nov. '78, 13 Nov. '80 (2 fish), Dec. '81 (2 fish); Westcliff Flats (VI) 12 May '76; zone VII 17 Sep. '76, 18 Nov. '76, 7 Sep. '78
[*Long rough dab *Hippoglossoides platessoides*	IV	0	0	W.Th. (IV) (Huddart 1971). Identification unconfirmed]
SOLEIDAE				
Dover sole *Solea solea*	II-VIII	7153	353 (17 Apr. '80)	
TETRAODONTIFORMES				
BALISTIDAE				
Trigger-fish *Balistes carolinensis*	III-IV	0	0	W.Th. (IV) 11 Dec. '74 (2 specimens); Barking (III) Nov. '75 (A. E. Hodges, personal communication)
MOLIDAE				
Sun-fish *Mola mola*	VI	0	0	Leigh-on-Sea (VI) autumn '79 (C. Hynson, personal communication)

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N.B. See Postscript overleaf

Postscript — The Thames Water Authority Salmon Rehabilitation Scheme

by M. J. Bulleid, P. J. Gough and N. A. Reader*

Following the recent significant improvements in the water quality of the River Thames estuary, the Thames Migratory Fish Committee, and more recently the Thames Water Authority, examined all constraining factors and concluded that the rehabilitation of Atlantic salmon to the Thames was feasible and the objective worthwhile. The scheme, which was implemented in 1979, consists of three phases lasting a total of seventeen years, during which time annual introductions of juvenile salmon, monitoring the return of adult salmon and the modification of weirs to simplify passage, were to be undertaken — embarkation on successive phases of the scheme being dependent on the success of the preceding phase.

Juvenile Stockings

In each of the first four years of phase I, up to 50,000 salmon parr have been released into carefully selected nursery tributaries and where possible these have been supplemented with smolt stockings. All smolts have been released into the lower river near Sunbury, having first been marked by adipose fin clipping. The totals released for the period 1979-1982 amount to 176,200 one-year-old parr and 7,800 one-year-old smolts.

Electrofishing surveys have revealed that although survival is very variable in the nursery streams, growth is excellent and these data are used in successive years for more rigorous selection of suitable sites. The surveys enable the calculation of pre-smolt escapement within each stream, however, the enumeration of the total annual smolt run is not possible in the absence of extensive trapping facilities. A good indication is obtained though by the recovery of smolts from intake screens of the estuarine power stations. During 1981 three clipped smolts were recovered at Tilbury 'B', just ten days after their release at Sunbury as well as four unmarked fish. Seven unmarked smolts were discovered during the late spring of 1982, and this evidence seems to suggest that good numbers of smolts may be successfully migrating through the estuary.

Adult Returns

In the absence of trapping facilities, the return of adult salmon has so far been monitored by the recovery of dead salmon, sightings of salmon leaping at the lower weirs and more recently by the electrofishing and removal of fish. Although electrofishing large Thames weirpools is probably very inefficient and non-quantitive, it is the only practical method available at present for estimating the magnitude of the run and obtaining brood stock for the production of future stock fish. Information on age and weight distributions of the run, sex ratio and the proportional return of salmon resulting from parr and smolt stockings is also obtainable. Between July 28th and October, 89 fish have been caught:—

Location		*Total No. caught*	*Weight range Kg.*	*Sex Ratio M:F*	*Number clipped*
R. Thames,	Teddington Weir	6	1.9 — 2.6	2:4	5
	Molesey Weir	49	1.2 — 4.85	27:21 *1NK**	30
	Sunbury	2	1.5 — 3.1	1:1	1
	Shepperton	8	1.9 — 5.7	5:3	5
	Chertsey	2	2.0 — 2.8	2:0	1
R. Wey	Bottom Weir	6	1.7 — 3.4	2:4	2
R. Mole	Zenith Weir	16	1.6 — 3.2	5:6 *5 NK**	8

**NK — Sex not known*

After examination and measuring, all fish were transported upstream to holding facilities in the Reading and Chesham areas where their condition has been continually monitored. The majority of these fish will be retained at these sites until they reach full maturity for use as broodstock — their progeny being used in the two years following as stock fish. The remainder of the fish have been transported further upstream and released into specially selected sites in the upper catchment where previous studies have suggested that they will be able to spawn naturally. Any fish caught surplus to these requirements are to be removed from the lower river and transported upstream to be released into the middle reaches of the river from where it is hoped that they will emmigrate to potential spawning sites.

Conclusion

The current return of salmon to the Thames has attracted a great deal of interest from the public and has revealed to many that the river is now restored to the clean state which existed up until the early nineteenth century. The results for 1982 suggest that the early comments in the 1977 Report of the Thames Migratory Fish Committee were indeed sound and that the rehabilitation scheme is certainly feasible. It is hoped that the use each year of returning adult salmon for the production of juvenile stock fish will steadily result in the establishment of a 'true' Thames salmon stock and that the observed percentage return of fish will therefore increase.

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Corophium curvispinum Sars (Crustacea: Amphipoda) recorded in the London Area

by JOHN H. BRATTON*

Corophium curvispinum Sars is one of the two truly freshwater members of this genus recorded in the British Isles (Lincoln 1979) and has previously been found in seven sites: River Avon, Tewkesbury (Crawford 1935); River Severn, Stourport, Worcestershire and the Grand Union Canal, Leicestershire (Moon 1970); the Coventry Canal at Lichfield, Staffordshire, the Oxford Canal at Coventry, Warwickshire, the Staffordshire/Worcester Canal, near Stafford and the Shropshire Union Canal, Cheshire (Gledhill, *et al.* 1976).

On 29 July 1981 *C. curvispinum* was found in beds of tape-grass *Vallisneria spiralis* in the River Lee Navigation, Cheshunt Marsh (TL371014). Subsequent sampling in this canal from the A406 bridge at Edmonton to fifty metres north of Cheshunt Lock (TL371033) has shown that *C. curvispinum* is present from Rammey Marsh (TQ375994) to this Cheshunt Lock site. The canal north of this point has not yet been sampled. *C. curvispinum* was also found at one site in the River Lee (TL375008).

Corophium curvispinum inhabits tubes of detritus and these were found near the leaf bases on *Vallisneria* and the leaf axils of *Potamogeton perfoliatus*. The apparent absence of *Corophium* south of Rammey Marsh may be related to the scarcity of submerged macrophytes.

Where *Corophium* occurs, its distribution is patchy. It was absent from some *Vallisneria* beds only about thirty metres from a bed where it was abundant. This uneven distribution was also noted by Moon (1970) though no reasons were suggested.

The known distribution of *C. curvispinum* in the River Lee Navigation constitutes three new county records, as it was found in stretches of the canal in Essex, Greater London and Hertfordshire.

I thank Dr R. G. Hughes, Dept. of Zoology, Westfield College, London, for confirming the identification of *C. curvispinum*.

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The Stripe-winged Grasshopper *Stenobothrus lineatus* (Panzer) in Bushy Park

by B. C. Townsend*

The stripe-winged grasshopper *Stenobothrus lineatus* is a warmth-loving insect which is locally common in southern England. Typically, it occures on south-facing slopes on chalk downland, notably the North and South downs and the Purbeck Hills. Away from such habitats, it is usually found on sandy soil (Ragge, 1965). Until now, this species has been unknown in Greater London north of the Thames.

While walking in Bushy Park on 21 August 1982, I heard a male stridulating beside the path. After a few minutes searching a second male was found. On a second visit a week later two more males were heard, at a spot about a hundred yards away. Although only sparsely distributed, it appears that this species may occur over quite a wide area of the Park.

In the same area small numbers of the common green grasshopper *Omocestus viridulus* occur, and the meadow grasshopper *Chorthippus parallelus* is extremely common. Several of the latter species may be disturbed with each step, making the search for the rarer species very tedious unless the songs can be heard. On both visits, although *O. viridulus* and *C. parallelus* were stridulating feeely, *S. lineatus* was singing only intermittently.

Away from the chalk south of the Thames, *S. lineatus* is known from Bookham and Wisley Commons (Payne, 1957), Esher, Runnymede and Richmond Park (B.M.(N.H.) material). All of these are sandy sites, whereas Bushy Park lies on the London clay.

The presence of *S. lineatus* in Bushy Park suggests that it may be worth looking for on other grassy sites in West Middlesex. It exemplifies the importance of the Royal Parks to wildlife at a time when pressure on the environment in the London Area is severe.

The nomenclature follows Ragge (1965).

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The Mosquitoes of Epping Forest

by

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Summary

In a survey of Epping Forest, Essex from March 1979 to April 1982, twelve species of mosquitoes (Diptera: Culicidae) were recorded. These included typical woodland species such as *Aedes cantans* and *Aedes punctor*, which were widely distributed and present in the greatest numbers, as well as more domestic species like *Culex pipiens* and *Culiseta annulata*. All three species of tree-hole-breeding mosquitoes were recorded, including the rare *Orthopodomyia pulchripalpis*.

Introduction

Epping Forest forms a crescent-shaped belt, about 20km in length, between Epping in Essex in the north and Forest Gate in metropolitan London in the south.

Approximately two-thirds of the forest comprises woodland while the remainder is open grassland; there are also a number of permanent lakes and ponds. The dominant trees are hornbeam *Carpinus betulus*, beech *Fagus sylvatica*, oak *Quercus robor* and *Q.petraea* and birch *Betula pendula*, with lesser numbers of holly *Ilex aquifolium*, maple *Acer campestre*, crab apple *Malus sylvestris*, London plane *Platanus acerifolia*, wild cherry *Prunus avium*, ash *Fraxinus excelsior*, elm *Ulmus* spp., horse chestnut *Aesculus hippocastanum* and sycamore *Acer pseudoplatanus*. In addition there are individual examples of other trees such as hazel *Corylus avellana* and service *Sorbus domestica*.

Geologically, Epping Forest consists largely of London Clay overlaid in places by Claygate Beds, Pebble Gravel, and Boulder Clay.

Because of its proximity to London and its popularity for recreational purposes it was considered important to determine which mosquitoes occur in Epping Forest and to obtain information on their distribution, abundance and life-histories. To date no survey of the mosquitoes of Epping Forest has been carried out although a few records are reported by Marshall (1938) and Nye (1954).

Methods

Due to the size of the Forest it was not possible to survey it throughout. Instead ten survey areas, each approximately ½km^2, were selected. These are described below and shown in Figure 1.

1. Lower Forest

The most northerly area of Epping Forest consisting of a triangular woodland together with an adjacent strip of woodland to the south. It is a dense broadleaved woodland, dominant trees being hornbeam, ash, oak, birch and holly. There is a permanent pond and a number of temporary pools.

2. 'Wake Arms' area

The area surveyed is between the London-Epping Road and the road to High Beach. It is wooded throughout with beech as the dominant tree species. There

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are examples of oak, birch and holly. No permanent ponds are present but there are numerous shallow temporary pools.

3. High Beach/Rushey Plain
The survey area incorporated Rushey Plain, a large open grassy area and an adjoining woodland characterised by large pollarded beech trees and little ground vegetation. There are no permanent ponds, but temporary pools occur along the edges of the wooded area.

4. 'Robin Hood' area
A triangular area extending from the 'Robin Hood' roundabout and delimited by the London-Epping Road and the Loughton Road. There is a large temporary pool but no permanent water present. The area is wooded throughout with beech being common and with lesser numbers of oak, hornbeam and birch.

5. Fairmead
A large open area surrounded by woodland characterised by oak, hornbeam and holly. There is one permanent pond and a number of areas liable to winter flooding.

6. Chingford Plain
The area surveyed contains one permanent and one semi-permanent pond. Much of the area is grassland but this adjoins woodland composed mainly of pollarded beech and oak.

7. Lords Bushes
Also called Knighton Wood, this area is isolated from the rest of Epping Forest by residential areas. It is densely wooded with beech, oak and holly mainly. There is no permanent water but temporary pools occur.

8. Oakhill
The survey area includes open grassland and woodland. Trees present include oak, ash and holly. The prominent feature is a small permanent pond, the surrounding area of which is subject to periodic flooding.

9. Leyton Flats
This area is diverse in its character and includes grassland and open wooded areas (mainly oak), two permanent ponds, several temporary pools and areas subject to flooding.

10. Wanstead Flats
Situated adjoining Forest Gate, this is the southern-most part of Epping Forest. It is a flat grassy area with small numbers of trees, mostly oak, London plane and horse chestnut. There are two permanent ponds but no temporary pools.

The collections and observations reported in this paper were made from March 1979 to April 1982, using the following survey methods:—

(a) collection of larvae and pupae by dipping and netting from ponds, ditches, woodland pools, artificial containers and tree-holes.
(b) collection of resting adults using aspirators and sweep-nets.
(c) netting of females attracted to human bait.

Identification was performed using the keys of Marshall (1938) and Mattingly (1950). Also the addition of *Culex torrentium* to the British fauna (Mattingly, 1951) was taken into consideration.

Mosquitoes Recorded in the Present Survey

The twelve species found in the present investigation can be grouped according to their breeding sites as follows:—

1. *Ditches and temporary pools*
   Aedes cantans (Meigen), *Aedes punctor* (Kirby), *Aedes rusticus* Rossi, *Culex pipiens* (L.), *Culiseta annulata* (Shrank), *Culiseta morsitans* (Theobald).
2. *Water-filled cavities in trees*
   Aedes geniculatus (Oliver), *Anopheles plumbeus* Stephens, *Orthopodomyia pulchipalpis* (Rondani).
3. *Water in artificial containers*
   Culex pipiens and *Culiseta annulata* may also be placed in this category.
4. *Permanent pools*
   Aedes cinereus (Meigen), *Anopheles claviger* (Meigen), *Anopheles messeae* Falleroni. *Culiseta morsitans* may also be placed in this category.

Notes on the species

The general distribution of the mosquitoes recorded in the survey can be seen in Table 1. The following notes give information on the abundance of the species and some details of their life-histories.

TABLE 1. The mosquitoes recorded in the present survey. An asterisk indicates the presence of the species at that site. The sites are described in the text and their situation shown in Figure 1.

SPECIES	SITE NUMBER									
	1	2	3	4	5	6	7	8	9	10
Aedes cantans	*	*	*	*	*	*	*	*	*	
Aedes cinereus								*		
Aedes geniculatus	*	*	*	*	*	*	*	*	*	*
Aedes punctor	*	*	*	*	*	*	*	*	*	
Aedes rusticus		*								
Anopheles claviger		*						*		
Anopheles messeae								*	*	
Anopheles plumbeus	*	*	*	*	*	*		*	*	
Culex pipiens	*	*	*	*	*	*	*	*	*	*
Culiseta annulata		*	*	*	*	*	*	*	*	
Culiseta morsitans		*						*	*	
Orthopodomyia pulchripalpis		*	*							

Aedes cantans

This species was found to be one of the most abundant in the woodland areas. Adults were collected at all sites with the exception of Wanstead Flats, where suitable breeding sites were absent. Females were readily attracted to human bait and showed a peak of biting activity around dusk. Males were collected on many occasions by sweeping and were observed resting in low vegetation especially bracken, holly and grass. Larvae and pupae were found, often in high densities, in roadside ditches and temporary woodland pools in partially shaded situations.

A. cantans was the predominant species in the Lower Forest, the 'Robin Hood' area, High Beach/Rushey Plain, Fairmead, Oakhill and Leyton Flats.

Hatching was normally found to occur from January onwards after autumn and winter rains had filled the ditches and depressions. The first adults emerged in April and larvae were not seen after the middle of May, by which time the pools were drying. The last adults of the season were trapped in mid-September.

Aedes cinereus

The only recorded breeding site of this uncommon mosquito was the flooded margins of a permanent pond at Oakhill. A small population was found in April,

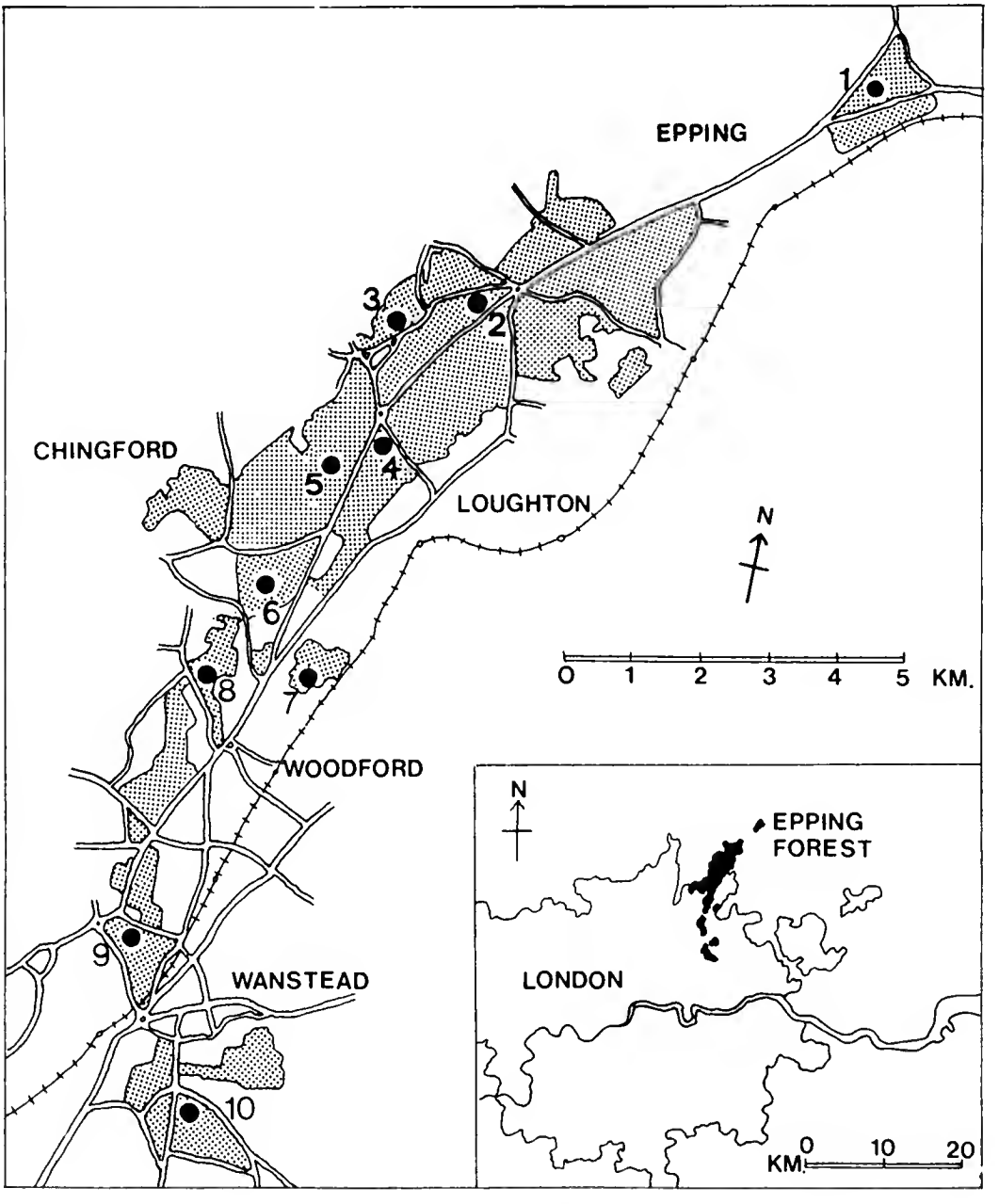

Fig. 1. Map of Epping Forest showing survey areas, with inset, London showing the situation of Epping Forest.

May and June. These observations agree with those of Marshall (1938) who reports that the winter is passed as the egg and that larvae appear from April to June. Adults are said to be on the wing from June to August but none was found in the present survey. Females of *A. cinereus* are known to be troublesome biters of humans.

Aedes geniculatus

This species is a troublesome biter in woodland areas and was located at every site examined, although in only small numbers. Despite intense searching, breeding sites were found at only four sites: 'Wake Arms' area, High Beach/Rushey plain, 'Robin Hood' area and Chingford Plain. In all but one tree-hole in which mosquitoes were present, *A. geniculatus* was the most abundant species. It was found in four of the ten known water-filled tree-holes in the 'Wake Arms' area and in all three of the tree-holes at High Beach.

Females were recorded attempting to bite from April to September and larvae were observed in every month of the year.

Aedes punctor

Like *A. cantans*, *A. punctor* breeds in ditches and woodland depressions and the two mosquitoes were often found together in the larval stages. At some sites, namely the 'Wake Arms' area, Chingford Plain and at Lords Bushes, *A. punctor* was the most numerous species as judged by both larvae and adults. At all the other sites, with the exception of Wanstead Flats, it was present but in lesser numbers.

The life-cycle follows a similar pattern to that of *A. cantans*, with the eggs, larvae, pupae and adults present at similar times of the year. Females of *A. punctor* bite people readily, especially at dusk.

Aedes rusticus

A third mosquito species which breeds in ditches and woodland pools in shaded situations is *A. rusticus*. Although reported to be a common mosquito in this country it was encountered on only a single occasion in the present survey when a small number of larvae were removed from a depression in the 'Wake Arms' area in the month of January. According to Marshall (1938) the larval season extends from October to June with all instars normally being present before the end of December. The adult season is reported as being from April to August although no adults were found in the present survey despite extensive trapping in suitable areas.

Anopheles claviger

The Oakhill area was the only recorded breeding site for this species. Larvae were found in March and May, but adults were not caught in this area although they are attracted to humans. However, adults were captured in the 'Wake Arms' area in June and July although at this site no breeding areas were discovered.

According to Marshall (1938), larvae can be found during all months of the year and adults are present from March until October.

Anopheles messeae

This species was encountered commonly as resting and overwintering forms in stables in the Leyton Flats area in all months of the year. It was also recorded as

females attracted to human bait in the vicinity of Oakhill from May to September. Eggs and larvae were not found in permanent ponds or other water masses adjacent to these areas. Marshall (1938) states that larvae may be found between April and October.

As brackish waters do not occur in the Epping Forest area it was assumed that all of the specimens caught were *A. messeae* and not the other British member of the *A. maculipennis* complex, namely *A. atroparvus*.

Anopheles plumbeus

This tree-hole-breeding mosquito was far less common than *A. geniculatus* in Epping Forest. Although it was recorded at all sites except Lords Bushes and Wanstead Flats, it was found in very low numbers as both larvae and adults. An exception was an occasion in June when large numbers of females were attracted to human bait at High Beach.

In the 'Wake Arms' area it was recorded from only one of the ten tree-holes and in the High Beach area in only one of the three tree-holes. *A. plumbeus* was recorded as larvae in all months of the year, while adults were found from late April to early October.

Culex pipiens

Females of this species feed on birds and so are not attracted to human bait. Eggs, larvae and pupae were collected from water troughs and other artificial containers as well as from shallow collections of ground water.

Males were collected from the 'Wake Arms' area, High Beach, the 'Robin Hood' area, Fairmead, Leyton Flats and Wanstead Flats, and their hypopygia examined. All specimens were found to be *C. pipiens* and none was the related *C. torrentium* which has been reported from the London area.

The duration of the larval stages was from April until November. Adults were located in all months of the year, both as active flies from April to October, and as overwintering forms from September to May. *C. pipiens* is thought to be the most common mosquito in Great Britain and is one of the most common in Epping Forest, being found at all ten sampling sites.

Culiseta annulata

This mosquito was located in all of the areas surveyed with the exception of Lower Forest and Wanstead Flats. It is a troublesome biter, particularly at dusk, and was found breeding in a variety of habitats including flooded grassland, woodland depressions and artificial accumulations of water.

Larvae were recorded from May to September only, although Marshall (1938) states that they have been collected in every month of the year. The first adults of the season were on the wing in April and could still be trapped as late as September. Blood-fed females were taken from a number of stables and outbuildings in the High Beach and Leyton Flats areas in July, September, December and March, verifying that the female is an overwintering stage.

Culiseta morsitans

Only three breeding sites of *C. morsitans* were discovered. At Leyton Flats and at Oakhill larvae were recorded from small permanent ponds in April, May and June. Larvae were also found in a temporary woodland pool at 'Wake Arms' in late December. According to Marshall (1938) the winter is passed as the larva

which may be encountered from September to June. Females are not attracted to human bait and were not found by sweeping vegetation. Marshall records adults from April to August.

Orthopodomyia pulchripalpis

This rare mosquito was found breeding at a single site at High Beach and two tree-holes in the 'Wake Arms' area in association with both *A. geniculatus* and *A. plumbeus*. In common with these other tree-hole breeders, larvae were present throughout the year. Females were not attracted to humans and the single capture of a resting adult was in July.

Species Recorded in Other Investigations but not in the Present Survey

Culiseta fumipennis Stephens

A species which breeds in either temporary pools or the weedy margins of permanent pools in open situations. Recorded by Nye (1954).

Culiseta litorea Shute

Normally a coastal mosquito but may breed in open pools. Recorded by Nye (1954).

Coquillettidia richiardii Ficalbi

Breeds in permanent pools and the larvae remain submerged, obtaining their oxygen by penetrating the roots and stems of certain aquatic plants. Recorded by Marshall (1938) and Nye (1954).

Acknowledgement

We wish to thank the Corporation of London for permission to conduct the survey.

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MATTINGLY, P. F. 1951. *Culex (Culex) torrentium* Martini, a mosquito new to Great Britain, *Nature* **168:** 172.

NYE, E. R. 1954. *The Flies of the London Area*. II. Culicidae. Sub-Family Culicinae (Mosquitoes). With key to the species of *Culex*. *Lond. Nat.* **34:** 114-126.

Note

Fucus and *Ulva* recolonisation along the Thames

Significant fucoid advance following amelioration of estuarine water conditions in the tidal Thames was recorded by Price and Tittley (1972) and by Tittley and Price (*Lond. Nat.* **56**, 1977). Recent (October 1982) field-work has revealed further advances by *Fucus vesiculosus*, *Fucus spiralis* and *Ulva lactuca* over the 1976 positions. Current limits for *F. vesiculosus* are Ford Ferry landing (TQ 495808; south bank) and Dagenham Dock (the present highest penetration, TQ 490817; north bank). Equivocal *Fucus* plants (probably *F. spiralis*) also appear at Dagenham Dock, together with healthy clumps of small *Ulva lactuca*, previously not present above Erith. The fucoids are vigorous and often fruiting. Compared with 1976, *F. vesiculosus* position has advanced 2.25km on the north bank and 0.85km on the south bank respectively; *Ulva lactuca* is now *c.*5.3km further upstream. Quantities of fruiting fucoid drift material imply that further penetration could occur, but physical factor limitation must be near. Fuller details will be published later.

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Hemiptera-Heteroptera of the London Area

PART XII

by Eric W. Groves*

(Previous parts of this paper have appeared in *The London Naturalist* as follows:Pt. I (**43:** 34-66, 1964); Pt. II (**44:** 82-110, 1965); Pt. III (**45:** 60-88, 1966); Pt. IV (**46:** 82-104, 1967); Pt. V (**47:** 50-80, 1968); Pt. VI (**48:** 86-120, 1969); Pt. VII (**50:** 87-94, 1972); Pt. VIII (**52:** 31-59, 1973); Pt. IX (**54:** 21-34, 1975); Pt. X (**55:** 6-15, 1976); and Pt. XI (**56:** 32-43, 1977). A continuing list of abbreviations as to sources of records and for recorders' names has appeared whenever apropriate at the beginning of the parts listed above and new additions to these are now given below.)

SOURCES OF RECORDS

The following are new sources of records

(a) Published and manuscript:

31. *Entomologist's mon. Mag.* **1,** 1864 →
    (h) BROWN, E. S. 1951. The identity of British *Velia* (Hem. Veliidae) with an account of a species new to Britain, **87:** 296-306.
33. *Entomologist* **1,** 1840-1842, 1864 →
    (e) BROWN, E. S. 1954. Notes on the rarer British species of aquatic and semi-aquatic Hemiptera: II. Veliidae, **87:** 45-53.
    (f) LANSBURY, I. 1954. Some notes on the ecology of the aquatic and semi-aquatic Hemiptera-Heteroptera and Coleoptera of four bomb-craters in Fairmead Bottom, Epping Forest, Essex, **87:** 77-82.
66. Records from the private collection R. R. Fowell.
67. *Trans. Soc. Br. Ent.* **1-19,** 1934-1971.
    (a) BROWN, E. S. 1948. A Contribution towards an ecological survey of the aquatic and semi-aquatic Hemiptera-Heteroptera (Waterbugs) of the British Isles, dealing chiefly with the Scottish Highlands, and East and South England, **9:** 151-195.
    (b) PEARCE, E. J. and WALTON, G. A. 1939. A contribution towards an ecological survey of the acquatic and semi-acquatic Hemiptera-Heteroptera (Water-bugs) of the British Isles, **6:** 149-180.
    (c) WALTON, G. A. 1943. The Water-Bugs (Rhynchota-Hemiptera) of North Somerset. **8:** 231-290.
68. *J. Soc. Br. Ent.* **1-6:** 1934-1959
    (a) WALTON, G. A. 1939. Two water-bugs new to Great Britain: *Microvelia pygmaea* Duf. and *Microvelia umbricola* Wrob. (Hemipt.), **2:** 26-33.
    (b) POPHAM, E. J. 1950. Water-bugs (Hemiptera-Heteroptera) of North Surrey, **3:** 158-173.
    (c) BRINKHURST, R. O. 1959. The Habitats of British *Gerris* and *Velia* species, **6:** 37-44.
69. ANON. 1964. Fauna and Flora of the River Darent (First Report). *Journal of Field Studies, New Cross Evening Institute for 1963.*
70. Record book of A. M. Massee now in the Entomology Dept., British Museum (Natural History), London.
71. LANSBURY, I. 1956. Some Notes on the ecology of the aquatic and semi-aquatic Hemiptera-Heteroptera and their associated fauna and flora in southern Hertfordshire and nort-eastern Middlesex. *Entomologist's Gaz.* **7:** 97-111, 157-166, and 213-223.

*Department of Botany, British Museum (Natural History), Cromwell Road, London SW7 5BD.

72. BROWN, E. S. 1941. Some aquatic Hemiptera-Heteroptera new to Hertfordshire, with notes on others found in the Hertford area. *Trans. Herts. nat. Hist. Soc. Fld Club* **21**(4): 266-271.
73. BROWN, E. S. 1943. A further addition to the list of Hertfordshire aquatic Hemiptera. *Trans. Herts. nat. Hist. Soc. Fld Club* **22**(3): 108.
74. LANSBURY, I. 1956. A list of the aquatic and semi-aquatic Hemiptera-Heteroptera recorded for Hertfordshire, with notes on species found in the Barnet area, *Trans. Herts. nat. Hist. Soc. Fld Club* **24**(5): 192-196.

(b) Museum and Society Collections:
RSM Royal Scottish Museum

(c) Other abbreviations:
Slough (ICBFS)=Imperial College Biological Station (now the Pest Infestation Laboratory, *see below*)
Slough (PILG)=In the grounds of the Pest Infestation Laboratory, Slough.*
n.c.=no collector
n.d.=no date

INDEX TO RECORDERS' NAMES

The following are abbreviations to recorders' names additional to those already listed in Parts I-VI.

C. J. F. Bensley *(CJFB)*
E. S. Brown *(ESB)*
R. O. Brinkhurst *(ROB)*
G. H. L. Dicker *(GHLD)*
R. R. Fowell *(RRF)*
A. E. LeGros *(AELeG)*
T. T. Macan *(TTM)*
E. J. Popham *(EJP)*
J. E. H. Roberts *(JEHR)*
A. E. Stubbs *(AES)*
G. A. Walton *(GAW)*

DIPSOCORIDAE

This small family of tiny, predatory bugs contains three British species, two of which have been found in the London area.

Ceratocombus coleoptratus (Zett.) Sp. 424 p.320
D & S p.514 *(C. muscorum)* S p.189
B p.305 (Sp.216)

Local. The adults of this small bug occur in moss and beneath dead leaves in damp places during August and September, the larvae of which have been found from July onwards. It is usually the brachypterous form of the adult which is met with, having forewings reaching (or slightly extending beyond) the tip of the abdomen. The much less common macropterous form has its large fore and hind wings both reaching the abdominal apex.

KENT. Bexley, *GCC* (BM) (37) (4); Westerham, 4.x.53, in thick moss under trees, *AMM* (70) (22).

SURREY. Oxshott Heath, 28.viii.04, on moss on a stump, both brachypterous and macropterous forms, *WM* (SL) (1/**1904-05**, 76); 16.ix.50, *WJLeQ* (21); Esher, ix.1864, *JAP* (BM) (28) (33) (3) (38); *GCC* (BM) (37); Esher Common, 19.ix.51, found commonly near spiky moss at roots of ling, *FJC* (SL); 17.ix.58, a single specimen in damp moss in woodland near the Black Pond, *AAA* (51); Claremont, *TRB* (37) (3); Weybridge, *JAP* (37) (3); and beyond the boundary at Chobham, *ES* (37) (3); Peaslake, viii.1892, *EAB* (BM); Ewhurst, viii.1892, *EAB* (BM); Ewhurst, viii.1896, hills to the east, a single macropterous form, *EAB* (BM) (3) (8); Holmbury, viii.1892, *EAB* (BM) (3); and Leith Hill, viii.1895, *EAB* (BM) (3).

BUCKS. Beyond the boundary at Hurley Chalk Pit, ix.64, *GEW* (BM).

*Now The Slough Laboratory, Ministry of Agriculture, Fisheries and Food.

Pachycoleus waltlii Fieb., 1860 Sp.425 p.321
(as *P. rufescens* Sahlb., 1875)

B p.306 (Sp.217)

Rare. Adults of this small flesh-coloured bug have been found in wet *Hypnum* moss amid marsh marigold *Caltha palustris* at the margins of streams and in wet *Sphagnum* below which trickling water was present. It is thought that the species has two generations a year; the overwintering adults pairing in early summer to produce larvae maturing by July or August. These adults mate probably in August to produce a second generation that become mature by October or November. All specimens collected in the British Isles have been brachypterous. It is believed that some ecological connection may exist between this bug and the marsh marigold.

SURREY. Beyond the boundary at Godalming, c.1957, in moss growing in association with *Caltha palustris*, *RWJU* in *DL* coll. (SL) (1/**1960**,18); and at Thursley, 15.v.60, Cosford Mill, in moss growing around *Caltha palustris* in a sunny situation, *DL* (SL) (1/**1960**, 18 and 78).

SALDIDAE (SHORE BUGS)

There are 21 British species in this family of small, though very agile, predatory bugs, of which 8 have so far been recorded in the London area.

Saldula orthochila (Fieb.) Sp.433 p.330
D. & S p.521 (*Salda orthochila*) S p.176 (*S. orthochila*)
B p.293 (Sp.204, *S. orthochila*)

Local. Overwintered adults, which are active again by the late Spring, pair in May and early June. The larvae become adults from July onwards occurring on sandy heaths, both on bare patches on the ground and beneath clumps of *Erica cinerea*.

MIDDX. Ruislip Reservoir, 20.ix.34, on mud flats, *DCT* (33a); Hillingdon, 26.ix.35, edge of pond, *DCT* (33a); and Harefield, 8.viii.54, *WJLeQ* (21).

HERTS. Lea Valley, *JAP* (BM).

ESSEX. Epping Forest (Loughton), *GCC* (BM); and beyond the boundary at Danbury Common, 10.vii.66, *PSB* (16).

KENT. Blackheath, 5.viii.67, 6.ix.57, 6.iv.68 (one only) and 23.vi.65 (2 specimens), in a derelict garden in moderate numbers at edge of bare patches where the soil was gravelly and with sparse, stunted vegetation, *AAA* (51); Plumstead, 20.ix.57, 3 specimens in a sandpit amongst debris of *Atriplex patula*, *AAA* (51) (22); Bostall Woods, 27.ix.58, a single specimen at roots of *Rumex acetosella*, etc., *AAA* (51) (22); Darenth Wood, 14.vii.63, *AMM* (70) (22), and beyond the boundary at Sevenoaks (Knole Park), 4.vii.65, *SL* (1/**1965**,59), *KCS* (22); and Gravesend, *TRB* (37).

SURREY. Dulwich, *TRB* (37); Wimbledon Common, *FJC* (62); Croham Hurst, *JAP* (BM); Shirley, *TRB* (37) (3); Addington, *D & S* (3); Addington Hills, *ES* (36); Reigate district *J & TL* (32); Headley, 6.ix.64, on footpath N. of Walton Park Wood, several adults running on patches of dry bare soil, *EWG* (24); *KCS* (14); Mickleham, *JAP* (BM); Headley Heath (High Ashurst), 20.ix.70, n.c. (BM); Bookham Common, *FJC* (62); Oxshott Heath, 30.vi.51, resting in cracks on dry places in flat area near the railway station, common, *FJC* (1/**1951-52**,73); 17.ix.58, in slightly damp, bare sandy areas, *AAA* (51); 11.vii.56, *GEW* (BM); West End Common, 21.vii.52, by pond on mud, *FJC* (62); (Black Hills) 11.v.51., adults and larvae resting beneath cracked mud-film, *FJC* (62); 9.vii.51 (nymphs) and 10.ix.51 (adults and nymphs), *FJC* (62); 4.x.54, on ground, *FJC* (62); Arbrook Common, *FJC* (62); on the boundary at Byfleet, *FJC* (62); and beyond at Chobham, 24.iii.35, *ECB* (NM); Woking *ES* (37) (3); Coldharbour, viii.1895, *EAB* (BM) (3); and Witley Common, 3.vii.56, *GEW* (BM) (33/**92**, 6-13).

BUCKS. On the boundary at Little Chalfont, vi.51 and 4.vii.51, *WJLeQ* (21); and just over at Slough, 1.vi.55 and 6.vi.55, *GEW* (BM); (Upton Court Road), vii.54, 23.vii.54 and ix.54, on waste plot occurring in the open and under black medick *Medicago lupulina*, *GEW* (BM) (33a).

Saldula saltatoria (Linn.) Sp. 434 p.330
D & S p.522 (*Salda saltatoria*) S p.180 (*S. saltatoria*)
B p.294 (Sp.205)

Local. This species occurs at the margins of ponds, ditches, and slow streams, often in large numbers running about on firm mud particularly when it is sunny. Adults which have overwintered at the bases of grass tufts pair between late April and June and the new generation becomes mature by July. Bucks records required.

MIDDX. Hampstead Heath, 1949, Spaniards Pond on mud and pond weed, *DL* (1/**1949-50,** 36-38); Finehley, 31.vii.43, *CHA* (17); Ruislip LNR, 9.viii.54, adults and larvae at roots of *Carex flacca*, RAPM (49); and Hounslow Heath, summer 1952, eommon on muddy floor of pit and on the gravel at edge of the water, *GEW* (33b).

HERTS. Elstree, 16.vii.44, *CHA* (17); Cheshunt, 6.v.11 *EAB* (BM); Cuffley 6.v.11 *EAB* (BM); Broxbourne, 16.iv.10, *EAB* (BM); and beyond the boundary at Aston, 27.iv.63, *PJLR* (20). [The reeord of *S. opacula* taken on mud and deeaying *Typha latifolia* by the River Ver at Colney Street, 10.iii.52, by M. G. Ridpath and reported as a new Herts. county reeord in EMM **89,** 32, may well be the var. *marginella* of *S. saltatoria* with which, as Southwood & Leston, *Land & Water Bugs of the British Isles*, p.332, point out, it has been frequently eonfused].

ESSEX. Epping Forest (Loughton), 22.x.64, by pond, *BSN* (58); (Chingford), 30.v.42, *PJLR* (20); Epping Green, 25.ix.64, on mud by duck pond, (58); and Waltham Abbey, 23.x.09, *EAB* (BM).

KENT. Lee, WW (4) (39) (22); Blackheath, 30.vii.61, 18.x.64, 21.iii.67, 9.iv.69, most often singly, oecasionally nymphs, not eommon, *AAA* (51) (22); Horton Kirby, ii.viii.69, a few individuals by sandy edge of mill-stream, *AAA* (51); Westerham, 12.x.21 *PH* (BM); and on the boundary at Gravesend, 23.xi.30, *ECB* (NM).

SURREY. Kew Gardens, 18.x.48, a single speeimen running over pebbles on shelf in the Tropical Pits, 'a most unexpeeted place to find this eommon mud hopper', *HKAS* (7/**1949,** 234); Riehmond Park, 26.x.04, *ECB* (NM); 19.ix.37, pond with stream running through it, *GAW* (67b); Reigate [prior to 1867], on houses [sic], *T & TL* (32); Redhill Common, [prior to 1867], at roots of grass, *J & TL* (32); Headley Lane, 11.ix.04, by sweeping, *WW* (60) (62); Boxhill, *WW* (62); Miekleham, *JAP* (BM); Epsom Common (Stew Ponds), 4.v.70, one example by smaller pond, *BSN* (58); Bookham Common, iv, vii, & x, *DL* (34); viii, *DL* (54); *DL* (62); 29.vii.50 *DL* (1/**1950-51,** 76); x.63, *PSB* (16); Oxshott Heath, summers of 1922 & 1923, in *Juncus bulbosus* in dried-up pools and as an early eoloniser of bare wet areas, *OWR* (61, pp.269 & 272 as *Acanthia saltatoria*); 8.v.49, *RDW* (SL) (62); 28.iv.63, *PJLR* (20); Esher Common (Blaek Pond), viii.09, *WW* (SL) (62); 26.vi.64, common on firm sandy mudded edge of pond, *AAA* (51); West End Common (Black Hills), 11.vi.51, on path, *FJC* (SL); Arbrook Common, 3.vi.40, on mud at edge of pond, *TRES* (13); and on the boundary at Wisley, *WW* (62); and beyond at Chobham Common, 25.iv.37 & 5.vii.33, *ECB* (NM); 15.iv.55 & 8.v.54, *GEW* (BM); and Basingstoke Canal, 1954-55, between Pirbright Bridge and Frimley Green, *HDS* (50).

Saldula pilosella (Thomson) Sp. 439 p.332
S p.181 (*Salda pilosella*) B p.298 (Sp. 209, *S. pilosella*)

Rare. This species has so far been recorded in the marshes of N. Kent only, where it has been taken by searching and sweeping from early summer (overwintered adults) to September (adults of the year). It should be looked for in those few Essex localities of estuarine salt marsh on the north side of the Thames that lie within the London area.

KENT. Erith, *WW* (39); Swanseombe Marshes, 9.v.64, *KCS* (14); and on the boundary at Gravesend, *JAP* (BM); *GCC* (BM); 24.ix.05, on mud, *WW* (60); and just beyond at Higham, 23.iv.46, on salt marsh, *AMM* (70); 27.vii.51, pond by Cement Works, *AMM* (70); 12.ix.59, *KCS* (14).

Saldula pallipes (Fab.) Sp. 440 p.333
D & S p.527 (*Salda pallipes*) S p.181 (*S. pallipes*)
B p. 298 (Sp. 210, *S. pallipes*)

Local. This species is found on the mud at the margin of flooded gravel pits or pools and puddles on sandy clays and gravels. As adults have been found as early as March, throughout the summer and then as late as November, it is probable

that there are two generations a year with the adults of the second generation overwintering.

MIDDX. Hendon, 5.iv.02 ♂ & ♀ and 3.v.02 ♀, *ECB* (NM); Hounslow Heath, summer 1952, eommon on muddy floor of the pit and on the gravel at the edge of the water, *GEW* (BM); and Sunbury, 11.vi.32, *AMM* (70).

HERTS. Beyond the boundary at Ashridge, 28.vi.64, *PSB* (16).

ESSEX. Epping Forest (Theydon Bois), 9.xi.63, *KCS* (14); (Loughton), 22.x.64, by ponds, *BSN* (58).

KENT. Bexley (Joyden's Wood), 11.vii.64, *KCS* (14); Farningham Wood, 29.ix.63, *KCS* (14); and just beyond the boundary at Birling, 4.ix.53, on marshy ground, *AMM* (70). [A. A. Allen (in litt.) regards the Blaekheath reeord attributed to him by Massee (22) as erroneous].

SURREY. Surrey Commercial Doeks, ix.20, V instar larvae and adult ♂ and ♀, *EAB* (BM); Riehmond Park, 18.vii.1899, (31); (EMM) Mickleham, 29.vi.11 ♂, *ECB* (NM); on the boundary at Wisley, 13.iii.65, *PSB* (16); and beyond at Chobham, *ES* (36); and Horsell Common, 27.viii.32 ♂, *ECB* (NM).

BUCKS. Wraysbury, 17.viii.60, *GEW* (BM).

Micracanthia marginalis (Fall.) S p.443 p.334

D & S p.524 (*Salda marginalis*) S p.180 (*S. marginalis*)

B p.292 (Sp. 201 *S. marginalis*)

Rare. The few records existing to date for this bug in the London area indicate that it is to be found during the months of July and August. It occurs in damp temporary hollows on heathland particularly those that may fill with water. The British form is the subspecies *immitator* Linnavuori.

SURREY. Esher Common, 1 & 3.viii.57 ♂ & ♀, *DL* (1/**1957,** 12 and EMM **93,** xlviii); and beyond the boundary at Chobham Common, viii, 1875, *ES* (10) (36) (37) (3); viii. *EAB* (BM); vii.57, *GEW* (1/**1957,** 12); 18.vii.59, 11.vi.60 & 21.vi.60, *GEW* (BM); and at Elstead Common, 12.vi.59, on rough wet ground in situation where *Drosera* and mosses grew, eommon, *AMM* (70); 16.vii.59, *GEW* (BM).

Chartoscirta cincta (H.-S.) Sp. 445 p.335

D & S p.531 (*Salda cincta*) S p.181 (*S. cincta*)

B p.301 (Sp. 213, *S. cincta*)

Common. This species occurs at the sides of rivers, streams and pools, and in marshy areas especially amongst *Juncus, Phragmites* and *Sparganium* and other waterside plants. The macropterous adults have been found as early as April and as late as September, indicating that there may be both an overwintering and a summer generation. It has been recorded in all counties within the Society's area.

MIDDX. Notting Hill, *JAP* (BM); Ruislip 21.viii.16, *EAB* (BM); Ruislip LNR, 16.viii.64, very common on mud beneath *Phalaris arundinacea, RAPM* (49); and Hounslow Heath, summer 1952, occurring sporadieally throughout the swamp 'where it was almost impossible to eateh', *GEW* (33b).

HERTS. Riekmansworth, 4.viii.57, *WJLeQ* (21); Brieket Wood, 15.iv.38, *HWJ* (43); and Lea Valley, Cheshunt, 5.ix.57, a single speeimen in damp reed debris, *AAA* (51).

ESSEX. Canning Town, TRB (37); Waltham Abbey, 23.iv.09, *EAB* (BM); Rainham, *TRB* (37); and Epping Forest, at roots, *CN* (35a); 3.v.13, *EAB* (BM); (Loughton), iii.06, *EAB* (BM).

KENT. Blaekheath, c.1952, in debris from edge of a pond (sinee destroyed) *AAA* (51) (22); 9.iv.69, on surfaee of pond in garden at 63 Blaekheath Park, *AAA* (51); Slade Green, near Erith Marshes, x.52, two speeimens in reedy ditch bank, *AAA* (51); Hither Green Lane, 1900, *WW* (1/**1900,** 760) (39); Lee, *D & S* (28) (37) (4) (22); *JAP* (BM); *GCC* (BM); (Burnt Ash Lane) *JAP* (BM); 20.iv.1900, pond near Grove Park, *WW* (60); Eltham, *D & S* (28) (37) (40) (22); Foot's Cray (Ruxley Gravel Pit), 15.xii.62, *KCS* (14) (22); 6.iv.63, *KCS* (14); and Darenth Wood, *GCC* (BM); and Westerham, 15.x.21, *PH* (BM).

SURREY. Wimbledon, GCC (BM); Reigate, *ES* (37) (3) (62); Redhill [prior to 1867], *J & TL* (32) (37) (3) (62); Bookham Common, iv, v, vii, ix, *DL* (34) (62); Esher Common (Blaek Pond) 15.viii.70, *BSN* (58); Weybridge, 22.ix.63, *PSB* (16); and on the boundary at Wisley, 17.ix.05, on mud near the large pond, *WW* (60); *GCC* (BM); and beyond at Chobham *ES* (37) (3) (62); Woking, *GCC* (BM); Shere, *EAN* (3); Guildford, *HCC* (BM); 12.iv.64, *PJLR* (20); and Shalford, *EAB* (3).

BUCKS. On the boundary at Little Chalfont, 18.vii.62, 1.ix.53 & 9.ix.53, *WJLeQ* (21); Fulmer, 30.viii.53, *WJLeQ* (21); and just beyond at Amersham, 13.ix.59 & 16.vii.64, *WJLeQ* (21); and at Slough, 15 & 20.vii.59 and 2.viii.56, in swamp, *GEW* (BM) (60).

Chartoscirta elegantula (Fall.) Sp.446 p.336
S p.183 (*Salda elegantula*) B p.303 (Sp. 215, *S. elegantula*)

Very rare and possibly now extinct in the London area. So far there has been only a single record for this bug within the Society's boundary and that was found over 90 years ago (see below) and not recorded since. It is a species which occurs in marshy areas beside rivers and in *Sphagnum* bogs.

MIDDX. Hammersmith [*circa* 1889), on the banks of the River Thames, rare, *JAP* (BM, 3 specimens) (36) (37).

Chartoscirta cocksi (Curtis) Sp. 447 p.336
D & S p.533 (*Salda elegantula*) S p.183 (*S. cocksi*)
B p.302 (Sp. 214, *S. cocksi*)

Local. The adults of this species have been found from spring to late summer in bogs and marshy areas, in *Sphagnum* and on mud between sedges. Unlike *C. cincta*, with which it may, it is said, occur, the adults are always brachypterous.

MIDDX. Ruislip LNR, 9.viii.64, adults and larva found on mud amongst *Carex flacca* *RAPM* (49); Northwood, 13.iii.43, *PJLR* (20).

ESSEX. West Ham marshes, *TRB* (37) (5); and Chingford, ix.1892, *CN* (35a); vii.1892, *EAB* (BM).

KENT. Birdbrook, *JAP* (BM).

SURREY. Wimbledon, *JAP* (BM); *EAN* (3); Reigate Heath, *JAP* (28) (3); Esher (West End Common), 9.viii.08, *WW* (60) (1/**1908-09**, 69) (62); and beyond the boundary at Chobham, *ES* (37(3)) (62); viii.1882. *EAB* (BM); *GCC* (BM); Chobham Common, 8.v.54 & 22.v.55, *GEW* (BM); 27.iv.68, 'a single specimen running over wet mud beside a stream under sallow' *AES* (1/**2**, 17, 1969); Woking, *ES* (37) (3) (62); *GCC* (BM); and Leith Hill, iii.1895, *EAB* (BM) (3).

MESOVELIDAE (PONDWEED BUGS)

The single British representative of this family of surface water bugs has been recorded in all counties in the London area except for Bucks.

Mesovelia furcata (Muls. & Rey) Pondweed bug Sp. 449 p.340
S p.146 B p.225 (Sp. 164)

Local. An uncommon bug found on large ponds and lakes where the water is still and contains pondweeds. It occasionally occurs on sections of rivers where the flow is slow and there is emergent vegetation. It favours the floating leaves of water plants such as *Potamogeton natans*, *Polygonum amphibium*, *Nymphaea alba* and *Nuphar lutea*. Between resting they dart about on the surface in search of small prey. The bug is said to play a part in the pollination of those flowers just mentioned. Pairing takes place in the late summer, the ♀ laying her eggs in the floating stems. The adults die off in late September and the eggs within the now dead weed stems sink to the bottom and overwinter there. The larvae emerge in April and May and swim to the surface to become mature by late July or early August.

MIDDX. Enfield (Wrotham Park), 20.ix.53 (20 adults) & 11.x.53 (a single adult), *IFL* (71); 22.v.71, a single nymph on large pasture pond, *BSN* (58).

HERTS. Barnet (Totteridge), 19.ix.37, in two pools by the roadside on floating leaves of *Potamogeton natans*, *GAW* (67b); (Hadley Green), 25.viii.53, in shallow area on N. side of a large pond, a single nymph, *IFL* (71); 25.ix.53, in a second, larger pond, adults abundant, IFL (71) (BM); and on the River Lea, 6.viii.40, between Hoddesdon and Rye House, just below the weir, a single nymph, *ESB* (67a) (72).

ESSEX. Epping, 30.viii.55, *PJLR* (20); Epping Forest, 26.vii.51, found in numbers in two ponds by main pond in vicinity of Robin Hood Hotel, no developed forms noted, *AAA* (70); 30.viii.55, *GEW* (BM); ix.1896. 10.ix.10. & 11.x.11, *EAB* (BM) (38); 4.ix.52, 4♂♂ & 1♀ *AMM* in *PH* coll. (BM); (Wake Valley Pond), 5.viii.40 & 3.ix.40, nymphs common on both dates, *ESB* (67a); *CN* (35a); 20.ix.10, ponds at Loughton. *WW* (60); (Loughton), *JWD* in *EAB* coll. (BM); 14.vi.16 & x.01, *EAB* (BM); 1.x.10, 2♂♂ & 1♀, *EAB* in *ECB* coll. (NM).

KENT. Beyond the boundary at Higham, 3.vii.65 in dyke adjacent to Thames estuary, *AMM* (70); 3.vii.65, *AMM* in *GEW* coll. (BM).

SURREY. Richmond Park, 23.ix.37, on lake amongst the small marginal *Scirpus*, *GAW* (67b); Leatherhead, 15.ix.23, *WEC* (BM); and beyond the boundary at Woking, *JWD* (BM); *JAP* (BM); Woking Canal, *ES* (37); and near Chobham, 24.ix.37, pool in small wood much shaded by trees, *GAW* (67b).

HEBRIDAE (SPHAGNUM BUGS)

Both the British representatives of this family have been found in the London area.

Hebrus pusillus (Fall.) Sp. 450 p.341
D & S p.266 S p.142 B p.222 (Sp. 162)

Rare. This bug is associated with *Lemna* and other aquatic plants and feeds on small insects and other arthropods. Overwintering females lay their eggs from mid-May onwards and the larvae pass through the five instars and become mature in about two months. Unlike *H. ruficeps* this species is always macropterous. Middx. and Bucks. records required.

HERTS. Hertford Heath, near Hertford, 30.iv.44 & 10.v.44, abundant in small pond on both dates, *ESB* (73).

ESSEX. Canning Town, *TSB* (37); and Rainham, *TRB* (37) (5).

KENT. Plumstead Marshes, vi. & vii., *D & S* (28) (22); *ES* (37); and beyond the boundary at Higham Marshes, 3.v.64, *AMM* (1/**1964**, 29) (22); 3.v.64, *KCS* (14); and at Cliffe, *KCS* (22).

SURREY. Merton, *JAP* (BM); Barnes, *GCC* (BM); and beyond the boundary at Chobham, *GCC* (BM); and Wisley, n.d., on mud at the margin of ponds, *PH* (67a).

Hebrus ruficeps (Thomas.) Sphagnum bug Sp. 451 p.342
S p.143 B p.223 (Sp. 163)

Local. More common than the previous species. It occurs at the sides of acid ponds, streams and lakes in wet *Sphagnum* and *Amblystegium* moss. The life cycle is similar to that of *H. pusillus*; the eggs being laid in the fronds and basal parts of the mosses. The adults are dimorphic and although brachypters are occasionally met with (macropters only rarely) the micropterous form is the more usual.

MIDDX. Harefield 12.ix.35, common in *Phragmites* beds, *DCT* (33a).

ESSEX. Epping Forest (Loughton), x.1884, in swarms in *Sphagnum* but only with one developed form seen, *TRB* (37) (5) (38) (35a); 12.iv.11 & 10.vi.11, *EAB* (BM); (Wake Valley Pond), in *Sphagnum*, *CN* (35a).

KENT. Beyond the boundary at Higham, *AMM* in *GEW* col. (BM) (12).

SURREY. Putney, *ECR* in *EAB* coll. (BM); Oxshott Heath, 16.ix.50, *WJLeQ* (21) (RSM); Esher Common (Black Pond), 29.iii.07, swarming on wet moss, *WW* (SL) (60); 2.ix.50, in *Sphagnum*, DL (1/**1950-51**, 79); 24.iv.54, in *Sphagnum*, SL (1/**1954-55**, 78); 21.v.51, 29.vi.53, 25.viii.52, 1.ix.52, 9.ix.52, 11.ix.50, & 7.x.52 (adults all the dates) and 22.viii.55 (nymphs), *FJC* (SL); and beyond the boundary at Chobham Common, in *Sphagnum*, *ES* (37) (3) (62); *GCC* (BM); Wisley, n.d. on *Sphagnum*, *PH* (67a); and Leith Hill, viii.1895, *EAB* (BM) (3) (38).

HYDROMETRIDAE (WATER-MEASURERS)

This is a world-wide family with but a single genus, all members being thin, delicate, aquatic bugs. It is represented in Britain by two species, the more common of which is found in the London area. Its slow gait, either when moving over waterside vegetation or 'walking' across the water with body slightly raised off the surface, is quite unmistakeable, hence its common name.

Hydrometra stagnorum (Linn.) Water-measurer Sp. 452 p.342
D & S p.576 (*Limnobates stagnorum*) S p.148
B p.234 (Sp. 166)

Widely distributed, though nowhere common. Usually met with as single specimens, found at the edges of ponds or water-filled ditches, and margins of streams. Overwintering adults pair in May and early June, the females laying eggs

on stems of aquatic plants at or just above the water level. The old adults may live on into July while newly hatched larvae become mature in about a month. Micropterous forms are the more usual; the brachypters being less so and true macropters very rare. Ostracods *(Cladocera)*, mosquito larvae and other small surface insects form the prey of the water-measurer. Bucks records required.

MIDDX. Hampstead Heath, 1949, beside Viaduct Pond, *DL* (1/**1949-50,** 36-38); 27.v.50, in pond on the Heath, *DL* (EMM **86,** 130); South Mimms (Mimms Wash Stream), 8.v.54 ♂ & ♀ and 13.v.54, 3♂♂, *IFL* (71); Enfield (Beech Hill Park lake), 25.ix.53, *IFL* (BM); 25.ix.53, 9♂♂ & 6♀♀, and 29.x.53, 1♂, *IFL* (71); Drayton, *JAP* (BM); Uxbridge (Swakeley's Pond), viii, 35, *DCT* (BM) (RSM).

HERTS. Lea Valley, Cheshunt, 5.ix.57, a single specimen on a reedy pool, *AAA* (51); 9.vi.58, a brachypetrous form swept from amongst reeds in the same area, *AAA* (51); and just beyond the boundary in the River Beame near Stapleford, *RP* (27).

ESSEX. Epping Forest, 26.viii.51, on pond with *Mesovelia, AAA* (51): 5.viii.40, in small pond on E. side of New Road, opposite Wake Valley Pond, 1♂,2♀♀, and 2 nymphs, *ESB* (67a); (Wake Valley Pond), vi.63, *PSB* (16); 3.ix.40, a single female, *ESB* (67a); *CN* (35a).

KENT. Below Lewisham in the River Ravensbourne, *WW* (1/**1901,** 36); Catford, 13.vi.01, on the River Ravensbourne on water plants, *WW* (60) (4) (39); Foots Cray, *KCS* (22); (Ruxley Gravel Pit), 21.i.61 & 31.v.62, *KCS* (14) (22); Stone, near Dartford, ii.iv.55, *KCS* (14); Darenth Wood, *HKK* (22); Horton Kirby, 11.viii.69, sandy stream bank, a braehypterous form with the wings reaching to near, but not attaining, the apex of the body, *AAA* (51); Riverhead, 1963, on the River Darent between the headspring and the tributary springs below the ponds, n.c. (69); and beyond the boundary at Higham marshes, 2.v.65, in a dyke, a maeropterous male (very rare in Britain) and several developed forms, *AMM* (1/**1965,** 52 & 57); 9.v.65, several maeropterous females, *AMM* (70).

SURREY. Riehmond Park, 9.x.04 & 26.xii.04, *ECB* (NM); Beddington Sewage Farm, 25.vii.52, *LC* (64); Oxted, 22.x.67, in Townland Pond, *RRF* (66); Burgh Heath, 18.vii.70, in shaded pond, one adult on marginal mud in vegetation, *BSN* (58); Headley, 25.iv.75, in water reservoir in Nower Wood, *RRF* (66); below Boxhill on the River Mole, 13.ix.53, *LC* (64); Betchworth, vi.27, *EAB* (BM); Epsom Common (Stew Ponds), 19.iv.39 & 26.iv.53, *EWG* (24); 18.iv.53, *LC* (64); 19.iv.53, *AEG* (1/**1953-54,** 8); (Lower Stew Pond), 19.vii.52, *LC* (64); Bookham Common, iii.52, in Gun Pit 'A', CJFB (2/**34,** 25); Weybridge, ii.53, beneath pieces of wood washed to the edge of a large pond at the side of the former Brooklands racing traek, *PSB* (16); and on the boundary at Byfleet, *FBD* (62); and beyond at Horsell, developed form, *JAP* (BM) (38) (62); Chobham, 24.ix.37, pool in small wood mueh shaded by trees, *GAW* (67b); Woking, 23.v.31, *FJC* (1/**1931-32,** 64) (62); Brookwood, *FJC* (62); Basingstoke Canal, 1954-55, between Pirbright Bridge and Frimley Green, *HDS* (50); Basingstoke Canal, 8.ix.40, a single ♀ in a streteh ½ mile N. and S. of Mitehett Lake, *ESB* (67a); and Friday Street, 9.x.66, in pond, *RRF* (66).

VELIIDAE (WATER-CRICKETS)

There are five British representatives of this family, four of which have been recorded in the London area. They are all small or minute and when on open water move, as Butler describes (38, p.237), 'with a fussy, jerky movement very different from the stately strides of the Gerridina'.

Velia caprai (Tam.) Water-cricket Sp. 454 p.344
D & S p.571 (*V. currens*) S p.149 (*V. currens*)
B p.240 (Sp. 168, *V. currens*)

Common. Found on slow-flowing streams and ditches, and occasionally on ponds that do not become affected by too much organic material. Overwintering adults pair in spring and lay eggs in moss and under stones at the water's margin during late May and early June. The larvae pass through five instars during the next six weeks and the new adults become mature by August. The old generation adults die off soon after mating although some females may still be present until the end of June. This species is always apterous. The bugs spend much of their time skimming the surface in effortless, graceful curves, facing the current and waiting for springtails and small spiders that may fall onto the water and be carried on the water towards them (Walton, 67c, 257).

MIDDX. Finchley, 16.v.43, *CHA* (17) (31h); South Mimms, 23.iv.54 & 8.v.54 ♀, in Mimms Wash Stream, *IFL* (71); Enfield Chase stream, v.49, *IFL* (71); Ruislip LNR, I instar

larvae noticed as early as April (7.iv.63, *WFS*) and throughout summer (24.vii.56, *EWG*) (49) (24), while some very late examples of larvae (possibly a second generation) were taken on 30.ix.64, *WFS* (69); adults seem to prefer the still or slower moving water where the vegetation overhangs, and have been taken from July onwards (24.vii.56 & 1.ix.55, *EWG*) (49); and at Drayton, *JAP* (BM).

HERTS. Barnet, viii.1885, *EAB* (BM); Cheshunt, 6.v.11 & 6.iv.12 (I instar larva), *EAB* (BM); Boxmoor, 8.x.45 & 21.iii.46, in streamlet parallel to the old canal, *BV* (EMM **85**, 249-253); 19.iv.46, abundant in shallow stream outlet on the Fishery Inn side of the bridge, *BV* (EMM **85**, 249-253); and near Hertford, 31.v.40 (nymphs, common) & 3.viii.40 (adults and nymphs, common) *ESB* (67a).

ESSEX. Epping Forest (Wake Valley Pond), 5.viii.40, adults and nymphs, abundant, *ESB* (67a).

KENT. Lee, *JAP* (BM); (Manor Farm), 23.iv.1898, in ditch, *WW* (60) (4) (22); Catford, 13.vi.01, on the River Ravensbourne, *WW* (60) (4) (22); Foots Cray (Ruxley Gravel Pit), 17.iii.63, *KCS* (14); and Bromley, 11.ix.64, *PJC* (63).

SURREY. 'Fulham' [*sic*], vi. [prior to 1833], in a running stream above The Bridge, on the Surrey side, *GS* (29); Wimbledon Common, *GCC* (BM); *FJC* (62); 1949-51, occasional in streams, *AJW* (19); 23.viii.46, in small stream draining from Kingsmere towards Roehampton and in another small stream draining the pond on S. side of Portsmouth Road [Jerry's Pond], *EJP* (68b); Carshalton, v.38, on stretch of slow-moving water between Westcroft Rd., and Mill Lane [at one time known as the Westcroft Canal[1]], *EWG* (24); Limpsfield, 11.iv.45, *CHA* (17) (31h); Redhill [prior to 1867], in ponds, *J & TL* (32); Epsom Common, 19.iv.39, in small pond S. of the culvert bank[2] of the Lower Stew Pond, *EWG* (24); (Stamford Green Pond), 27.iv.40, *EWG* (24); Bookham Common, 8.v.55, in Bookham Stream near the stone bridge, S.W. of the I.O.W. enclosure, *CJFB* (2/**38**, 57-58), *CJFB* in *EWG* coll. (24); 1960-70, ♀♀ often wingless and erratic in appearance, turning up in Crater pond, I.O.W. Pond, Lower and Upper Eastern Ponds, in the gun pits, and in the ditches, in late summer, in places where the flow of water is slow, *AELeG* (2/**52**, 77); Oxshott Heath, 1922-25, in drainage ditches dug after tree felling, *OWR* (61); 30.iv.38, *FDB* (62); Esher Common, 23.iii.31, undeveloped form on water surface of ditches, *FJC* (1/**1931-32**, 49); (Black Pond), 31.vi.31, ♂♂,♀♀ & nymphs, in ditch, skating on the film, *FJC* (SL); 15.vi.58, II & III instar larvae, *EWG* (24); 7.x.52, taken by pulling grass at sides of ditches, *FJC* (SL); Arbrook Common, 24.v.53, common, Dr. S. Asahina (and seen by *FJC*) (62); and on the boundary at Dorking, *JAP* (BM); Byfleet, 4.v.47, in pond on outskirts of the town, *SL* (1/**1947-48**, 60); and beyond near Chobham, 24.ix.37, in a pool in a small wood much shaded by trees, *GAW* (67b); Woking, *GCC* (BM); Brookwood, *FJC* (62); Leith Hill woods, 20.ii.66, several seen in fast stream of springs, *BSN* (58); and Chiddingfold, 14.vii.12 & 5.viii.16, ECB (NM).

BUCKS. On the boundary at Chalfont St. Peter, 18.vii.25, II & III instar larvae, *EAB* (BM); and just beyond near Amersham, 1902, *HJT* (1/**1903**, 6); and at Latimer Stream, 10.ix.71, in flowing ditch, a single nymph, *BSN* (58).

Velia saulii Tam. Sp. 455 p.345

Rare. This bug was recognised as British by Brown in 1951 (see 31h), and is mainly a northern (Cumberland and southern Scotland) species, except for one locality in Suffolk and two in the London area (cited below). The adults which have been taken in April and from June to September, are unlike *V. caprai* in that they favour larger areas of open water such as would be found on lakes and rivers. The male has almost rectangular black markings on the laterotergites, larger than those in *caprai* which are always triangular.

HERTS. River Lea at Broxbourne, 13.iv.47, macropterous ♂, *ESB* (EMM, **87**, 304).

ESSEX. River Lea, Cheshunt, 29.iv.58, ('an apterous ♀ amongst floating debris at the edge of the river (on the Essex side) near Cheshunt station, and another apterous ♀ by fishing in shallow water at the edge of a large lake in a disused gravel pit by the same bank but about ½ mile further upstream, *AAA* (EMM **95**, 71).

[A specimen from Oxshott, Surrey, 4.vi.1897, collected by E. C. Bedwell (now in Norwich Museum) may be this species as pointed out by E. S. Brown (33c, p.51-52) but needs dissecting to confirm its identity.]

1. The bed of this former canal is now (1982) a dried-up ditch along the western side of the recently built Sports Centre.
2. This pond ceased to exist in 1975 when six acres of the Common south of the culvert bank were flooded to form a large lake by damming up the stream, thus restoring the former medieval Great Pond that had been on this site until drained between 1843 and 1867.

Microvelia reticulata (Burm.) Minute water-cricket Sp. 456 p.346
D & S p.574 (*M. pygmaea*) S p.150 (*M. pygmaea*)
B p.238 (Sp. 167)

Frequent and widely distributed, sometimes abundant. It occurs on large ponds, canals, and gravel-pits, often swimming around in open patches amongst emergent vegetation (e.g. *Phragmitis*, *Carex*, etc.) at the margins, particularly if protected from the wind by high banks or trees. Overwintered females lay eggs in late April or beginning of May, the larvae becoming adult from June onwards. A further generation, possibly two if a good season, may follow. Adults of this species are usually apterous; the macropters being rare. Bucks records required.

MIDDX. Hampstead Heath, 27.v.50, pond on the Heath, common, *DL* (EMM, **86**, 130); and Stanmore, 26.viii.51, *IFL* (BM).

HERTS. Barnet (Totteridge), 19.ix.37, pool by roadside, *GAW* (67b); (Hadley Green), 6.v.53 (Pond D) & 25.ix.53, pond, *IFL* (BM); (Broad Colney), 29.vii.51, *IFL* (BM); (Dyrham Park), 20.ix.53, locality No. 1, *IFL* (BM); near Hertford Heath, 3.iv.40 (♂ & ♀), 4.iv.40 (2♂♂ & 10♀♀) and 12.vi.40 (about 20 nymphs), all in same small woodland pond, *ESB* (67a); and Haileybury, iv.,vi. & vii.40, apterous forms in two small ponds, *ESB* (72).

ESSEX. Epping Forest, 12.v.17, *EAB* (BM); (Fairmead Bottom), 19.iv.52 (bomb-crater No. 4 [=D], pH 7:0) & 29.ix.52 (bomb-crater No. 2 [=B], *IFL* (BM) (33f); (Loughton), 30.iii.12, 12.iv.11, 18.vi.10, 11.ix.11, x.01, & 2.xi.12, all *EAB* (BM); (Wake Valley Pond), 5.viii.40 (2♀♀, 1♀ & 1 nymph) and 3.ix.40 (2♂♂, 6♀♀ & 5 nymphs), *ESB* (67a); n.d., *CN* (35a).

KENT. Plumstead Marshes, 27.iv., *D & S* (28) (4) (22); below Lewisham in the River Ravensbourne, n.d., developed form *WW* (1/**1901**, 36); Lee, 16.iv.1898, at the pond, *WW* (60) (4) (22); *JAP* (BM); *GCC* (BM, under *M. pygmaea*); Grove Park, *WW* (4) (22); Foots Cray (Ruxley Gravel Pit), 15.xii.62, *KCS* (14) (22); and beyond the boundary at Gravesend, 27.iv.16, *ECB* (NM); and Higham Marshes, 5.ix.63, *KCS* (14); 2.v.65, a single developed form, *AMM* (1/**1965**, 57).

SURREY. Reigate, *ES* (37) (3); Earlswood Common [prior to 1867] in pond, *J & TL* (32); Boxhill, vi.36, 13 specimens, *WEC* (BM, under *M. pygmaea*); Bookham Common, 11.iv.54, on I.O.W. pond, *EWG* (24); iv.,vii. & ix, amongst and around *Potamogeton natans* at I.O.W. pond, *DL* (1/**1950-51**, 76); Esher Common (Black Pond), 2.ix.50, *DL* (1/**1950-51**, 79); 24.ix.54, in *Sphagnum*, *SL* (1/**1954-55**, 78); 15.viii.70, locally abundant on the mere, *BSN* (58); and on the boundary at Byfleet (Basingstoke Canal), 8.vii.50, very abundant all along the canal both adults and last instar larvae, no macropters found, *DL* (1/**1950-51**, 73); and beyond near Chobham, *ES* (37) (3); 24.ix.37, pool in small wood much shaded by trees, *GAW* (67b); Horsell, *JAP* (BM); Woking, *JAP* (BM); *GCC* (BM, under *M. pygmaea*); and on the Basingstoke Canal between Pirbright Bridge and Frimley Green, early part of 1954, between Locks 19 & 20, *HDS* (50).

Microvelia pygmaea (Duf.) Sp. 457 p.346

Rare. The true *M. pygmaea*, a Mediterranean species, was not recognised as British until 1939 (see 68a) and earlier records (certainly those from the London area) under this name before that date are referrable to the more common *M. reticulata*. *M. pygmaea* has been confirmed in only a few southern counties in Britain, one record of which was found near the boundary of the London area (see below).

HERTS. Just over the boundary along the River Mimram, Hertford, 7.vi.51 a single apterous ♂ amongst *Carex vesicaria*, *ESB* (33e).

GERRIDAE (POND-SKATERS)

Nine species out of the 10 British representatives of this family have been recorded in the London area. To many naturalists the gerrids are probably the most familiar of all water insects because of their characteristic mode of propelling themselves across an expanse of water. They achieve this with the middle pair of legs (the longest*) rowing simultaneously while the rear pair act as twin rudders for steering. The much smaller front legs, which play no part in propulsion, are modified to grasp and guide towards the mouth parts any insect prey that has been chased or is found struggling on the surface.

*All other British Heteroptera have the hind pair of legs developed the longest.

Limnoporus rufoscutellatus Foreign sp. p.356
S p.153 (*Gerris rufoscutellata*) B p.246 (Sp. 169, *G. rufoscutellata*)

A rare migrant which though common and widely distributed on the Continent has been recorded in Britain 17 times in the last 115 years, taken between March and June all on ponds (except for one record on a woodland puddle). It has never succeeded in establishing itself here. Only one record refers to the London area (see below) and one on the boundary. This species is an unmistakable gerrid covered with a golden pubescence which is recognisable 'even at a distance of 6-8ft' if the sun is shining (*fide* Dicker in Leston, EMM **92,** 189).

KENT. On the boundary at Gravesend, summer 1943, a single female on ornamental garden pond, *TRES* (6/**7**, 149) (EMM **83,** 104).

SURREY. Norbury, 4.iv.1893, *RML* (Entom. **26,** 52).

Gerris argentatus Schumm. Little pond-skater Sp. 359 p.348
D & S p.568 (*Hydrometra argentata*) S p.157
B p.254 (Sp. 177)

Occasional. This is the smallest of all the British *Gerris*. It is found on ponds and in ditches. Adults pair in mid or late April and the new generation larvae become mature in June. These are paler in colour and recognizable from the darker overwintered adults which may still be present. A second generation coming to maturity from August onward goes into hibernation in October or November. Bucks records required.

MIDDX. Hampstead Heath, pre-1914, *C. H. Rudge* (per *D. L. Leston* in EMM **86,** 130); Uxbridge, 9.ix.34 & 26.ix.35, ponds, *DCT* (33a); and Osterley [*circa* 1957], on an ornamental lake, *ROB* (63c).

HERTS. Cheshunt (Lea Valley marshes), 16.ix.59, two examples at edge of gravel-pit lake, *AAA* (51).

ESSEX. Epping Forest (Loughton), iv.02, v.02, 13.vii.16 (IV instar larva), 10.ix.10, 10.ix.14 (III instar larva) & x.1893, all *EAB* (BM); and (Wake Valley Pond) 5.viii.40 (1♂, 2♀♀) & 3.ix.40 (9♂♂, 2♀♀), *ESB* (67a); *CN* (35a).

KENT. Catford, 13.vi.01, *WW* (60) (4) (39) (22); Upper Belvedere, 12.vii.59, *RGR* (WBM); Foots Cray (Ruxley Gravel Pit), 15.xii.62, *KCS* (14) (22); and beyond the boundary at Higham Marshes, ix.10, *ECB* (70).

SURREY. Reigate, *ES* (3) (37) (36); Esher, *JAP* (BM); 14.v.1870, *ES* (BM) (36); *GCC* (BM); and beyond the boundary at Chobham, *ES* (3) (37); 24.ix.37, pool in a small wood much shaded by trees, *GAW* (67b); Horsell, *JAP* adult ♀, (BM); Woking, 31.vii.1875 & 5.x.1878, *ES* (BM); *GCC* (BM); Holmwood [*circa* 1957], in Fourwents Pond, *ROB* (68c); and Felbridge, 1.ix.37, six specimens from a pond, *AMM* (70).

Gerris lateralis Schumm. subsp. *asper* (Fieb.) Sp. 460 p.349
S p.155 (*G. aspera*) B p.251 (Sp. 174)

Rare. A species more confined to northern Britain found in peaty pools and still or stagnant water in ditches. There are three records from Surrey (see below) for which there is possibly doubt, so confirmation is needed.

SURREY. Richmond Park, 27.viii.46, in Leg of Mutton Pond, a quarter of a mile W. of the Robin Hood Gate, *EJP* (68b); Merton, *JAP* (BM); and beyond the boundary at Bisley, 16.vi.74, in Stafford Lake, *RRF* (66).

Gerris thoracicus Schumm. Sp. 461 p.350
D & S p.562 (*Hydrometra thoracica*) S p.155
B p.250 (Sp. 173)

Frequent. Prefers slow-flowing streams, detritus-filled pools, silted-up ponds and ditches. The adults pair in early spring and eggs are laid in late April and May on the floating leaves of *Potamogeton* and other aquatic weeds. The larval instars require about six weeks before reaching the adult stage. Both macropterous and apterous forms are met with. Bucks records required.

MIDDX. Hampstead, 1884-88, *FAW* (23); Hampstead Heath, 1949, Viaduct Pond, very common, *DL* (1/**1949-50,** 36-38); 1.iv.50, *DL* (EMM **86,** 130); Finchley, 18.iv.43, *CHA* (17); Enfield (Beech Hill Park), 26.iii.53, a single ♀ taken in the northern end of the lake, *IFL* (71); (Wrotham Park), 21.iv.72, in a large open pond, a single ♀, *BSN* (58); South

Mimms, 8.v.54, in the Mimms Wash Stream, one ♂ & two ♀♀, *IFL* (71); and Greenford, 13.iv.12, *EAB* (BM).

HERTS. Waltham Cross (Goff's Oak), 4.vi.60, on garden pond at 24 The Drive, *FB* (18); Cheshunt, 6.v.11, *EAB* (BM); Rye Meads, 16.iv.67, 19.iv.69, 21.iv.68 & 7.viii.71, in effluent channels of the Sewage Purification Works, *BSN* (58); Lemsford Springs, 21.v.72, in small peat pool, *BSN* (58); 25.iv.71, in former watercress beds at S. end, *BSN* (58); Broxbourne (Baas Lane), 5.viii.60, in garden pool on clay, *BSN* (58); Broxbournebury Gravel Pit, 21.iv.72, in shallow pool, *BSN* (58); Hoddesdon (High Leigh) 15.vii.65, a few examples in gravel pit pool, *BSN* (58); near Hoddesdon, 19.vi.40, a single male in pool in a disused gravel pit, *ESB* (67a); 1 mile S.W. of Cole Green, near Hertford, 4.viii.40, a single female in intereonnecting pools in a sandy gravel pit, *ESB* (67a); near Hertford Heath, 4.iv.40 (a single example in a small woodland pond) and 23.vi.40 (in a small pond in an open field, common), *ESB* (67a); and Barnet (Hadley Green), 26.iii.53, a single male in pond, *IFL* (71).

ESSEX. Epping Forest (Loughton), *CN* (35a); (Fairmead Bottom), 10.iv.52, a single ♀ in bomb-crater pool, *IFL* (33f); and just beyond the boundary at Corringham, 7.iv.55, *KCS* (14).

KENT. Lee, *WW* (39), *GCC* (BM); Catford, *WW* (39); Plumstead Marshes, 11.v.1895, in ditches, *WW* (60) (4) (39) (22); Blackheath, in garden pond 3.iv.59 (7 adults); 24.vii.59 (nymphs and adults), 29.vii.59 (nymphs maturing), 1.viii.59 & 12.vii.59 (adults), seareer since but a few seen most years in the Spring (last observed, 3.v.70), *AAA* (51) (22); Abbey Wood Marshes, 16.iv.55, *KCS* (14) (22); and beyond the boundary at Gravesend, *GCC* (BM); (Filbro' marshes), 24.ix.48 & 5.iv.47, in diteh, *TRES* (13); and Higham Marshes, 2.v.65, *AMM* (1/**1965**, 57) (22); 5.ix.63, *KCS* (14); and Leybourne, 14.ix.46, *GEW* (BM).

SURREY. Anerley, *DS* (BM); Richmond Park, 19.ix.37, in pond with stream flowing through it, *GAW* (67b); (Leg of Mutton Pond), 27.viii.46, *EJP* (68b); Shirley Common, 1.v.1897, pond in the wood, *WW* (60) (62); Westerham, 28.iv.23, *PH* (BM); and beyond the boundary at Horsell, *FJC* (62); Woking, *GCC* (BM); and Byfleet (Basingstoke Canal), 4.v.47, *FJC* (1/**1947-48**, 60).

Gerris costai (H.-S.) Sp. 462 p.350

Popham (68b) recorded this bug from three separate ponds on Wimbledon Common, Surrey, 23 & 24.viii.46, but in view of the fact that this species is essentially from habitats in the Scottish Highlands, becoming scarcer towards its southern limits of distribution in the southern Pennines and North Wales, its presence so far south must be treated as doubtful. It is possible that it was a misidentification for *G. thoracicus*.

Gerris gibbifer Schumm. Sp. 463 p.351

D & S p.564 (*Hydrometra gibbifera*) S p.156 (*G. gibbifera*)
B p.251 (Sp. 175)

Widely distributed though not generally common. Found in ponds, ditches and canals. The overwintering adults may sometimes be seen on warm days as early as January but most appear between late March and early May. Pairing and egg laying takes place soon afterwards and the ensuing larvae become adult by late July. There is a second generation whose adults mature in late September. Macropterous forms are more usual than the brachypters. Middx. records required.

HERTS. Barnet (Hadley Green), 6.v.53, in pond, a single maeropterous ♂, *IFL* (71) (74); Hoddesdon (High Leigh), 15.vii.65, in shallow gravel-pit pool, several adults including a single macropter, *BSN* (58); Broxbournebury Gravel Pit, 18.x.70, one female maeropter in a small pool, *BSN* (58); Bayford, 25.iv.62, in village pond partly shaded, *BSN* (58); and Hertingfordbury, 25.iv.62, in the River Lee, *BSN* (16).

ESSEX. Epping Forest, 7.x.62, *PSB* (16).

KENT. Brockley, *WW* (39); Lee, *WW* (4) (39) (22); Catford, *WW* (4) (39) (22); Blackheath, in garden pond, more common there than *G. thoracicus*, breeding freely there as a rule; first noted 3.iv.59; in plenty 29.iii.68, 7.iv.69 and all that month; nymphs common e.g. 1.vii.69, all records of *AAA* (51) (22); Kidbrooke, *WW* (39); and Bexley, 12.v.54, *KCS* (14) (22).

SURREY. Richmond Park, 27.viii.46, in small open pond 100 yards N.E. of the Ham Gate, and another in a large pond S. side of road from Ham Gate to the Richmond Gate, both records of *EJP* (68b); Wimbledon Common, 24.viii.46, in a small pool in a bomb-crater 50 yards W. of the boathouse on Queensmere, *EJP* (68b); Putney Heath,

24.viii.46, in small open ditch, *EJP* (68b); Mitcham Common, 13.iv.52, *LC* (54); Croham Hurst, 23.iv.21, *JLH* (60); Shirley Common, 1.v.1897 & 7.v.1898, pond in the wood, *WW* (60) (62); Addington, 17.iii.52, *RLC* (BM); Reigate, *GCC* (BM); Epsom, in garden pool, 24.iv.68 (three adults),3.v.70 (about 10 adults very active, much chasing, and some mating) & 1.ix.68 (two adults and many larvae), *BSN* (58); Epsom Common, 19.iv.39, on Stew Ponds, *EWG* (24); 16.iv.50, on Stamford Green pond and on the southern Stew Pond, *EWG* (24); Ashtead, *FJC* (62); Ashtead Common, 19.vii.47, skimming on the water in bomb holes, *SL*(1/**1947-48,** 67); Bookham Common, 9.v.54, on Eastern Plain in Gun Pit C, *EWG* (24); 9.v.54, in Bookham Stream, *IFL* (2/**38,** 57-8); Oxshott Heath, 30.iv.38, *FDB* (62); Esher Common, 1922-25, on surface of deep temporary pools colonized by *Juncus bulbosus* and also found aestivating in a dried up pool, *OWR* (61); 6.v.52, on both Black Pond and on swamp nearby, and 25.viii.52, abundant on Black Pond amongst *Sphagnum*, both records *FJC* (62); and beyond the boundary at Woking, *GCC* (BM); and Byfleet (Basingstoke Canal), 4.v.47, *SL* (1/**1947-48,** 60).

Bucks. Just over the boundary at Hodgemoor Wood, 2 miles S. of Amersham, 11.v.51, *WJLeQ* (21).

Gerris lacustris (Linn.) Sp. 464 p.352
D & S p.566 (*Hydrometra lacustris*) Sp.156
B p.252 (Sp. 176)

Common and widely distributed. Found in slow flowing streams and meandering rivers, and on ponds and ditches, often those that have a high organic matter content. The overwintering adults appear in late April or May; pairing and egg laying taking place soon afterwards. The larvae become mature from late June onwards, both macropterous and short-winged forms (apters, micropters and brachypters) being present. A second generation becomes adult from mid-August onwards and individuals may be found still active as late as the end of October or early November.

Middx. Hampstead Heath, 1949, at Spaniards Pond, *DL* (1/**1949-50,** 36-38); Enfield (Chase Stream), v.49, *IFL* (BM); (Wrotham Park), 22.v.71, large pasture pond, *BSN* (58); (Dyrham Park) 17.v.53, 1♂ & 1♀, in small pond, and 2♂♂ & 1♀ from an overgrown ornamental pond, *IFL* (71); (Beech Hill Lake), 25.ix.53, *IFL* (BM); South Mimms (Mimms Wash Stream), 20.ix.53 (4♂♂ & 3♀♀), 11.x.53 (7♂♂ & 2♀♀), 8.v.54 (3♂♂ & 3♀♀) and 13.v.54 (12♂♂ & 6♀♀); Stanmore, 26.viii.51 & 30.viii.51, *IFL* (BM); Stanmore Ponds, 14.x.70, frequent in the acid ponds, *BSN* (58); Ruislip LNR, 1963-64, common or abundant on open water, and also present on the slower flowing stretches of East Stream, *WFS*; 24.vii.56, *EWG* (49); Perivale, ix.63, on pond in the Selborne Society's sanctuary, *PSB* (16).

Herts. Barnet, 26.iv.43, *CHA* (17); (Hadley Green), 6.v.53 (♂♂ & ♀♀ on three separate ponds), 25.viii.53 (♂♂ & ♀♀ taken on a small circular pond) 25.ix.53 & 29.x.53 (♂♂ & ♀♀ taken from a large pond and the small pond), and 22.xi.53 (a ♀ taken from the small pond) — all records *IFL* (71); single representative specimens of these gatherings are deposited in BM as follows:- 2.v.52, 15.v.49, 13.vii.49, 24.iv.45 & 25.ix.53, all *IFL* (BM); 30.x.70, adults frequent in West Pond and one taken on East Pond, *BSN* (58); (Hadley Common), 25.viii.53 (2♂♂) & 25.ix.53 (5♂♂ & 4♀♀) in small circular pond, *IFL* (71); (Totteridge), 19.ix.37, pool by the roadside, *GAW* (67b); near Haileybury, has occurred on at least four ponds, *ESB* (72); Watford East, 30.x.70, on the River Colne, a single male in a shallow part, *BSN* (58); Chorleywood Common, 27.v.63, *PSB* (16); 10.ix.71, on overgrown ponds, common, *BSN* (58); Colney Heath (River Colne), 30.x.70, a single♂ in shallow part of the river and 28.viii.71 on river pools, fairly common, *BSN* (58); (North Orbital Road), 28.viii.71, on a stream of the River Colne, fairly common *BSN* (58); Broad Colney (River Colne), 1.x.71, on river, frequent, *BSN* (58); River Ver/River Colne confluence, 1.x.71, on river, frequent, *BSN* (58); London Colney, 14.x.70, on River Colne, common, *BSN* (58); Essendon (Wild Hill), 1.v.71, a shallow field pond, *BSN* (58); Cheshunt, 17.viii.60, a single example in the canal, *AAA* (51); (Turnford Brook), 18.viii.71, on shallow stream, 2 nymphs, *BSN* (58); (Cadmore Lane Gravel Pit), 18.viii.71, a single adult, *BSN* (58); (Lea Navigation), 18.viii.71, locally fairly common, *BSN* (58); Rye House, 18.ix.71, on the Rivers Lea and Stort, fairly common to common at various sites, *BSN* (58); Rye Meads, in the various effluent channels and streams of the Sewage Purification Works, 28.ii.70 (five brachypters hibernating on underside of a plank lying on the ground five feet from the stream), 18.iii.72 (a few in a deep pool); 19.iv.69 (common in slow stream), 21.iv.68, 25.iv.70 (single male possibly from hibernation), 20.vii.68 (several adults, one a brachypter), 24.vii.71 (fairly common), 25.vii.70 (adults and nymphs, all instars) in N. Meads Pool, 24.viii.68 (very common), 21.ix.68 (fairly common), 27.ix.64 (a single adult) and 20.x.68

(frequent to fairly eommon) — all records *BSN* (58); (Tollstream Gravel Pit), 4.ix.71, very eommon under willow trees on dyke, *BSN* (58); Lemsford Springs, 2.v.71 (in former watereress beds), 7.v.72 (on peat pool), 8.viii.71 (adult and nymph in W. ehannel), 15.viii.71 & 22.viii.71 (adults and nymphs eommon at S. end of old watereress beds) — all reeords *BSN* (58); Broxbourne Woods, 6.iv.40 ♀ & 13.vii.40 (2♂♂,1♀) in large woodland pond, *ESB* (67a); Broxbourne Meads, 10.v.62, in wet gravel pit, *BSN* (58); Broxbourne-bury Gravel Pit, 18.x.70, two braehypters in small pools, *BSN* (58); near Hoddesdon, 19.vi.40 ♂, in pool of disused gravel pit, *ESB* (67a); on the River Lea, about half-way between Hoddesdon and Rye House, 6.viii.40 (2♀♀), *ESB* (67a); Gt. Amwell pool (New River), 16.v.71, adults fairly eommon, *BSN* (58); Haileybury College grounds, 21.iv.40 (3♂♂ & 1♀), 25.v.40 (several) & 7.viii.40 (eommon) in sunken brick pool in vegetable garden *ESB* (67a); Bayford, 25.iv.62, on village pond, *BSN* (58); Hertingfordbury (River Lea), 25.iv.62 (adults) & 18.ix.71 (nymphs, frequent), *BSN* (58); 1 mile S.W. of Cole Green, on the N.W. side of the Hertford-Hatfield road, 4.viii.40 (2♂♂ & 1♀), in pool in sandy gravel pit, *ESB* (67a); Hertford Heath, 6.v. 62, in pond, *BSN* (58); near Hertford Heath in a pond partly overhung by trees (5.vii.40 1♂ & 3.ix.40 3♂♂ & 1♀); in a small pond in an open field (23.vi.40, common), and in another smaller pond (29.v.40 2♂♂ & 1♀); and River Lea (Marshall's Heath), 5.ix.71, locally eommon, *BSN* (58).

Essex. Epping Forest, ponds, *CN* (35a); 29.iv.60, *KCS* (14); 3.vi.63, *PSB* (16); (Wake Valley Pond), 5.viii.40 (1♂) & 3.ix.40 (3♂♂ & 1♀), *ESB* (67a); 21.iv.60, *FB* (18); (N.E. of Wake Arms), 21.x.62, *BSN* (58); (Wake Arms), 21.iv.60, in bomb erater, *FB* (18); (Fairmead Bottom), bomb crater A.-19.iv.52 (5♂♂ & 6♀♀) & 28.ix.52 (1♂), bomb crater B.-10.v.52 (1♂), 19.iv.52 (7♂♂ & 6♀♀), bomb erater C.-19.iv.52 (4♂♂ & 5♀♀) and 28.ix.52 (1♂), bomb crater D.-10.iv.52 (1♀), 19.iv.52 (12♂♂ & 7♀♀), 28.ix.52 (1♀), — all reeords *IFL* (33f); single representative specimens of these gatherings are deposited in BM as follows: bomb erater 1[=A], pH 7.0 — 19.iv.52, bomb crater 2[=B], pH 7.0 — 19.iv.52 and 29.ix.52, bomb erater 3[=C] — 29.ix.52, and bomb crater 4[=D], 19.iv.52, all *IFL* (BM); (Loughton) [*circa* 1957], eommon on flooded gravel pits surrounded by trees and overhanging bushes, *ROB* (68e); (Chingford), 1.v.11, *EAB* (BM); (Buekhurst Hill, 2.ix.25, II, III, IV & V instar larvae, *EAB* (BM); Lower Nazeing, 25.iv.62, on Perry Hill pond, six adults, *BSN* (58); Nazeing (Middle Street), 25.ix.64, in pond, 3 brachypterous females, 1 maeropterous male and 1 nymph, *BSN* (58); and Rye Meads, 9.v.63, in the Stort navigation, fairly eommon, *BSN* (58).

Kent. Blaekheath, *WW* (39); 2.ix.59, a single small female at 63 Blaekheath Park, settling in the sun not far from pond in garden, *AAA* (51) (22); Lee *WW* (3) (39) (22); Catford, *WW* (3) (39) (22); Kidbrooke, *WW* (38); Swanseombe, 12.vii.64, *PSB* (16); and on the boundary at Gravesend, 1943, on garden ornamental pond, *TRES* (6/**7**, 149); and beyond at Filbro' Marshes near Gravesend, 5.iv.47 & 24.ix.48, in ditch, *TRES* (13); Swaleeliffe, *EAB* (3); and Higham Marshes, 2.v.65, *AMM* (1/**1965**, 57).

Surrey. Riehmond Park, 3.x.25 & 8.x.25, *JEHR*; 27.viii.46, at three separate loealities in the Park, viz. Leg of Mutton Pond, in an open pond elose to the Ham Gate, and in a bomb erater by the road from Ham Gate to the Riehmond Gate, *EJP* (68b); Wimbledon Common, 23.viii.46, in Kingsmere, *EJP* (68b); 23.viii.46, on open pond on the S. side of Portsmouth Road [=Jerry's Pond] and in another smaller pond 200 yards W. of Kingsmere, *EJP* (68b); 24.viii.46, in small closed pond in woodland 300 yards W. of Kingsmere, *ESP* (68b); 24.viii.46, in small bomb erater W. of the Queensmere boathouse, and another in a larger bomb erater in woodland 300 yards S.W. of Caesar's Well, *EJP* (68b); 24.viii.46, in a large pond by the Putney-Wimbledon road [=Parkside] about ½ mile from the Wimbledon end, *EJP* (68b); 24.vii.46, in small horse pond near the Putney-Wimbledon Road [=Parkside] about ¼ mile from Tibbets Corner, *EJP*; Streatham, 24.viii.63, on garden pond of house in Mount Nod Road, *PSB* (16); Haekbridge (Grange Park), 15.iv.39, on stream running through the grounds, *EWG* (24); Ewell, 1.iv.39, River Hogsmill, on surfaee, *EWG* (24); Shirley Common, 1897, *WW* (60) (62); Reigate, *GCC* (BM); Redhill [prior to 1867], in ponds, *J & TL* (32); Burgh Heath, 18.vii.70, in shallow sandy pond, loeally fairly common, *BSN* (58); Headley Lane, winter, in Happy Valley, *ROB* (EMM, **92**, 374); Epsom Common (Stew Ponds), 19.iv.39, *EWG* (24); 24.v.70, in both larger and smaller ponds, fairly eommon, *BSN* (24); Leatherhead, vi.25, *WEC* (BM); Bookham Common, ix., *DL* (34); 26.v.63, *PJLR* (20); Esher, 5♂♂ & 3♀♀, *JAP* (BM); 1922-25, eommon on the surfaee of deep temporary pools eolonized by *Juncus bulbosus*, *OWR* (61); 22.iv.33, *AEG* (SL); 2.viii.70, in small elay pit, fairly common, *BSN* (58); (Blaek Pond), 18.v.01, *SWK* (1/**1901**, 12); 2.viii.70, common, *BSN* (58); and on the boundary at Byfleet (Basingstoke Canal), 4.v.47, *SL* (1/**1947-48**, 60); and beyond at Chobham, 24.ix.37, pond in a small wood mueh shaded by trees and many dead leaves, *GAW* (67b); Horsell, *FJC* (62); Woking, *GCC* (BM); Basingstoke Canal, 1954-55, between Pirbright Bridge and Frimley Green, *HDS* (50); Basingstoke, 8.ix.40 (11♂♂ & 7♀♀) & 1.i.40 (1♂ & 2♀♀), in a streteh ½ mile N. &

S. of Mitchett Lake, *ESB* (67a); Guildford, *GCC* (BM); Holmwood [*circa* 1957], on Fourwents pond, *ROB* (68c); and Thursley Common, 5.v.75, on the bog in Upper Ditch, *RRF* (66).

BUCKS. Beyond the boundary at Cholesbury, N.W. of Chesham, 20.ix.81, *WJLeQ* (21).

Gerris odontogaster (Zett.) Toothed pond-skater Sp. 465 p.353
S p.157 B p.255 (Sp. 178)

Frequent. Found by lakesides, on weedy canals and in ditches, preferring cleaner water than *G. lacustris* and *G. thoracicus*. Adults pair and lay eggs in early spring, larvae becoming adult in April and May. A second generation developing through late June and July, are adult from August onwards. Individuals of this second generation may still be active until late October. Bucks records required.

MIDDX. Hampstead Heath, 1949, at Spaniards Pond, *DL* (1/**1949-50**, 36-38); 1.vi.50, *DL* (EMM **86**, 130); Enfield (Dyrham Park), 20.ix.53, in an overgrown ornamental pond, 6♂♂ & 5♀♀, *IFL* (71); 30.x.70, a single male in stream, *BSN* (58); (Wrotham Park), 11.x.53, a single male in a large cattle pond, *IFL* (71); 22.v.71, a single male in same pond, *BSN* (58); (Beech Hill Park), at northern end of the lake, 25.viii.53 3♂♂ & 2♀♀, and 25.ix.53 3♂♂ & 3♀♀; South Mimms, 8.v.53 (2♂♂ & 3♀♀) and 8.v.54♀, in Mimms Wash Stream, *IFL* (71).

HERTS. Barnet (Hadley Green), 2.v.52, *IFL* (BM); 26.iv.53 1♂ in pond, 23.iv.53 (6♂♂ & 7♀♀), 6.v.53 (2♂♂ & 4♀♀) and 25.ix.53 (3♂♂ & 2♀♀) in slightly large pond, and 6.v.53 (2♂♂ & 1♀) in another smaller circular pond — all records *IFL* (71); 25.ix.53 *IFL* (BM); 30.x.71, in C. Pond, fairly common, *BSN* (58); 29.v.71 in SW Pond, a single female, *BSN* (58); (Hadley Common), 25.viii.53 & 25.ix.53 (6♂♂ & 5♀♀), in small circular pond on the Common, *IFL* (71); Rickmansworth, 22.iv.51, *WJLeQ* (21); Chorleywood Common, 27.v.63, *PSB* (16); Broad Colney, 29.vii.51, *IFL* (BM); near Hatfield (Park Gate Gravel pits), 4.v.52, *IFL* (BM); Cheshunt, 6.iv.12, *EAB* (BM); 5.ix.57, a single specimen at edge of lake, *AAA* (51); (Northmet Gravel Pit), 30.ix.64, common in sheltered water amongst Lesser Reed Mace *Typha angustifolia*, *BSN* (58); Rye Meads, in various effluent channels and streams of the Sewage Purification Works, viii.61 (♂ & ♀), 10.x.64, macropterous ♂ in deep pond, 16.iv.67 1♂ & 1♀ in fast stream, 21.iv.65 1♂ in weedy channel; 19.iv.69, adults in slow stream, 25.iv.70 1♀ in concrete manhole, 19.vi.71, very common amongst *Polygonum amphibium* in effluent lagoon, and 18.iii.72, common in deep pool N. Meadow — all records of *BSN* (58); Stanstead Gravel Pit, 25.iii.72, a single female in W. pool, *BSN* (58); 22.viii.71, pool N.E. of Stanstead Abbots Gravel Pit, adults and nymphs, common, *BSN* (58); Broxbourne Woods, 6.iv.40, (2♀♀), in large woodland pond, *ESB* (67a) (72); Cole Green, 4.viii.40, abundant, *ESB* (72); Broxbourne-bury Gravel Pit, 21.iv.72, fairly common in small gravel pond, *BSN* (58); near Hoddesdon, 17.vi.40 (5♂♂ & 13♀♀), pool in disused gravel pit, *ESB* (67a); in the River Lea, 4.viii.40, a single male about half way between Hoddesdon and Rye House, and 7♂♂ & 3♀♀ below the weir just E. of Hoddesdon, *ESB* (67a); near Hertford Heath, 5.iv.40 (some present) and 9.vii.40 (2♂♂), in pond partly overhung by trees, *ESB* (67a); 26.vi.40 (2♂♂ & 2♀♀) in pond in Goldings Wood, *ESB* (67a); and beyond the boundary at Bishop's End near Tring, 20.iv.52, *IFL* (BM).

ESSEX. Epping Forest, 7.x.62, *PSB* (16); (Fairmead Bottom), 28.ix.52, in New Pond, *IFL* (BM); (Fairmead Bottom) bomb crater A.-19.iv.52 (♂ & 2♀♀), *IFL* (33f) (BM), and bomb crater B.-10.iv.52♀, *IFL* (33f) (BM); (High Beech), 22.x.64, about 10 examples in pond, *BSN* (58); (Wake Valley Pond), 3.ix.40, 2♂♂, *ESB* (67a).

KENT. Blackheath, 23.iii.59, 2.&3.iv.59 and 22.iv.59, single specimens on each date from pond in garden at 63 Blackheath Park, *AAA* (51) (22); Upper Belvedere, 12.vii.59, *RGR* (WBM); below Lewisham in River Ravensbourne, *WW* (1/**1901**, 36); Lee, 1897, *WW* (36) (3) (39) (22); Foots Cray (Ruxley Gravel Pit), 3.i.65, in grass tufts, *KCS* (14); Dartford Marshes, 5.x.52, 2 adults in dykes, *IFL* (BM); and on the boundary at Gravesend, *ES* (36); and beyond on Filbro' Marshes near Gravesend, 24.ix.48, in ditch, *TRES* (13); and Higham Marshes, 2.v.65, *AMM* (1/**1965**, 57); 29.iii.38, (5♂♂ & 2♀♀), *GHLD* (BM).

SURREY. Wimbledon Common, 24.viii.46, on small pool in a bomb crater 50 yards W. of Queensmere Boat House, *EJP* (68b); Hackbridge (Grange Park), 15.iv.39, on stream flowing through the grounds, *EWG* (24); Shirley Common, *WW* (62); Reigate, *ES* (36); Epsom Common, 16.iv.50, on Stamford Green pond, *EWG* (24); Bookham Common, 11.iv.54, ♂ on SE Pond and ♂ & ♀ on I.O.W. Pond, *EWG* (24); iv, vii & ix., the dominant gerrid on I.O.W. Pond, *DL* (34); viii., *DL* (54); 29.vii.50, *DL* (1/**1950-51**, 76); 12.iv.53 & 31.viii.60, *DGH* (57); *FDB* (62); Esher, 19.iv.1870, *ES* (BM) (36); *JAP* (BM); 22.iv.33, *AEG* (SL); (Black Pond), 15.viii.70, fairly common, *BSN* (58); on the boundary at Byfleet (Basingstoke Canal), 4.v.57, *SL* (1/**1947-48**, 60); and beyond at Horsell, *JAP* (BM); *FJC*

(62); Woking, *GCC* (BM); *FJC* (62); Basingstoke Canal, 1954-55, between Pirbright Bridge and Frimley Green, *HDS* (50); and Holmwood [*c.*1947], in Fourwents Ponds, *ROB* (68e).

Aquarius najas (DeGeer) River pond-skater Sp. 466 p.354
D & S p.560 (*Hydrometra najas*) S p.154 (*Gerris najas*)
B p.248 (Sp. 171, *G. najas*)

Widely distributed but nowhere common. Found on more open and swifter running water (e.g. on rivers, canals, etc.) than the gerrids already mentioned. Overwintering adults pair in May; the eggs being laid in early June beneath the water. The larvae soon swim to the surface after hatching. Mature bugs of the year are found from July or August until October. They tend to huddle together on the surface in a close pack if they occur in numbers at any one locality and constantly row against the current to maintain position. The apterous form is that most often found. Essex and Bucks. records required.

MIDDX. Enfield, 16.iv.04, *ECB* (NM).

HERTS. River Lea, at intervals, *ESB* (72); and in the New River, locally common, *ESB* (72); Cheshunt (Cedars Park), 22.vi.60, in New River, *FB* (18); (Church Lane), 22.x.70, fairly common in river by road bridge, *BSN* (58); Stanstead Abbots, 31.x.70, a few in river by A414 road bridge, *BSN* (58); Amwell (New River), 10.x.64 and 10.x.70 (adults fairly common and nymphs common); Gt. Amwell Pool (New River), abundant, *ESB* (72); 13.iii.71 & 16.v.71, a few in sheltered spots, *BSN* (58); River Lea [1940], half-way between Hoddesdon and Rye House, a small colony, *ESB* (67a); Broxbourne (New River), abundant, *ESB* (72); 7.v.61, *BSN* (58).

KENT. Below Lewisham, 4.ix.1897, in River Ravensbourne, *WW* (60) (1/**1901**, 36); Catford, x.09, in the Ravensbourne, *WW* (60) (4) (39) (22); and Ladywell, 17.v.1868, 2 specimens, *JAP* (BM).

SURREY. Reigate, *ES* (37) (3); Weybridge, 1.vi.25, ♀♀ much swollen with eggs 'so eggs laid after June 1st', *WEC* (marginal annotation in BM copy of Butler's, *A Biology of British Hemiptera-Heteroptera*); and on the boundary at Ripley, viii.1900, *EAB* (BM) (3) and beyond at Woking, *GWK* (3); Chobham, viii.1882, *EAB* (BM) (7) (3); and Basingstoke Canal, 1954-55, between Pirbright Bridge and Frimley Green, *HDS* (50).

Aquarius paludum (Fab.) Sp. 467 p.355
D & S p.559 (*Hydrometra paludum*)
S p.154 (*Gerris paludum*)
B p.246 (Sp. 170, *G. paludum*)

Rare. This large, active, south-eastern British species occurs on rivers, streams and lakes, 'skating over the surface with very great vigour and power' *vide* Butler (38). They tend to keep away from the banks making capture often difficult. Overwintering adults pair in the late spring, the larvae becoming mature by August. The macropterous adults are more common than the brachypterous forms. Middx. & Essex records required.

HERTS. Rickmansworth (Batchworth Lake), 26.vii.53, common on the lake but only a single male could be caught, *PNL* per *IFL* (74).

KENT. Eltham, *ES* (37) (4) (36) (22); and beyond the boundary at Filbro' Marshes near Gravesend, 24.ix.48, in ditch, *TRES* (13) and Tonbridge (River Medway), 2.x.46, *AMM* (NM).

SURREY. Shirley, 1897, 1♀, *WW* (60); Caterham, 15.vii.1876, *JS* (BM); *ES* (36) (37); *GCC* (3); Dorking, ix.1868, *JAP* in *JAP* coll. (2 specimens) (BM); Esher, 14.v.1870, *JAP* (BM); 1922-25, on surface of deep temporary pools colonized by *Juncus bulbosus*, *OWR* (61); and beyond at Chobham, *ES* (37) (3); Woking, 1878 1♂, *JAP* (BM); *GWK* (3); Basingstoke Canal, 8.ix.40, quite common along two short stretches N. & S. of Mitchett Lake, 'but difficult to catch', *ESB* (67a); and at Little Frensham Pond, 6.vii.41, nine specimens, *TTM* (BM).

BUCKS. Just over the boundary at Stoke Common, 22.v.53, *WJLeQ* (21).

(End of Part XII)

Further Observations on the Food of Tawny Owls in London

by Geoffrey Beven*

Summary

Tawny Owl pellets were examined from two open spaces (Hampstead Heath and Richmond Park) and one outer suburb (Esher) in London. The results are compared with those in central London (Holland Park) and Bookham Common, Surrey (Beven 1965). At Hampstead Heath nine species of mammals were taken by the owls in spite of the site being only five miles from St. Paul's Cathedral, whereas at Holland Park only four species of mammals were taken, presumably because Holland Park is a much smaller open space surrounded by a densely built up area. At Richmond Park the owls fed extensively on rabbits. They also took a great many dung beetles *Typhaeus typhoeus*. Frogs were extensively eaten at Hampstead Heath, 133 (15.5%) and at Esher 91 (15.2%), where also eight goldfish were taken.

Introduction

Previous observations (Beven 1965) have shown that tawny owls *Strix aluco* living in central London (Holland Park) may eat as much as 93% birds and only about 7% mammals. However, those living in the country on the outskirts of London, in the oakwood at Bookham Common, feed on 90% mammals and 10% birds. Southern (1956) found in his much more detailed investigation, similar results in the oakwoods near Oxford. In London food seems to be intermediate in the places between the two extremes (see Beven 1965). There is now information from three more localities in the London area and these show several points of interest.

Method of Study

After separation of the bones from the regurgitated pellets the animals are mainly identified by their skulls, and the numbers of the different species are counted (prey items). In order to estimate the proportion of the different animals in the diet, some correction is needed for their unequal weight, and the method used by Southern (1954) is followed. The mean weight, 20 grammes, of a small mammal is taken as one prey unit and the numbers of individuals of the other species are multiplied by the ratio of the weights of each species to the prey unit (Conversion Factor). The quantity of each species is thus expressed by weight as prey units and also as a percentage of the total prey units. Small mean weights are taken for larger prey such as the rabbit (200 grammes) because young animals are mainly taken or a large animal may be only partially eaten. Invertebrate prey such as earthworms in fibre pellets, and beetles, cannot easily be expressed by weight.

Localities

a) Hampstead Heath

About five miles to the north of St. Paul's Cathedral, and was searched for tawny owl pellets from 1967 to 1980, chiefly by Kate E. Springett. Some pellets were also collected by Evelyn P. Brown and David G. Garbutt. The pellets were found on Sandy Heath and West Heath, Northwood and various sites in Kenwood. There are a number of small ponds on the Heath. The vertebrate food is shown in Table 1, the frog numbers in more details in Table 4 and the beetles in Table 5.

b) Richmond Park

About 10 miles from St. Paul's. Pellets were collected from 1966 to 1969 by E. M. Forsyth, helped latterly by Sheila A. Bills. The areas worked were the Sawpit and

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TABLE 1 Vertebrate and beetle prey of tawny owls on Hampstead Heath, 1967-1980.

	C.F.	*Jan.-Apr.*			*May-Aug.*			*Sep.-Dec.*			*Total*		
MAMMALS		items	units	%	items	units	%	items	units	%	items	units	%
Mole	5	2	10	2.2	2	10	3.1	0	0	0	4	20	2.3
Common shrew	0.5	1	0.5	0.1	0	0	0	0	0	0	1	0.5	.06
Rabbit	10	3	30	6.7	4	40	12.2	0	0	0	7	70	8.1
Grey squirrel	25	1	25	5.6	0	0	0	0	0	0	1	25	2.9
Bank-vole	1	0	0	0	1	1	0.3	0	0	0	1	1	0.1
Field-vole	1	102	102	22.9	64	64	19.6	26	26	30.2	192	192	22.3
Wood-mouse	1	40	40	9.0	27	27	8.3	9	9	10.4	76	76	8.8
House-mouse	1	2	2	0.5	0	0	0	0	0	0	2	2	0.2
Brown rat	5	5	25	5.6	1	5	1.5	0	0	0	6	30	3.5
Small mammal	1	0	0	0	2	2	0.5	0	0	0	2	2	0.2
BIRDS													
Woodpigeon	15	0	0	0	1	15	4.6	1	15	17.4	2	30	3.5
Feral pigeon	10	2	20	4.5	0	0	0	0	0	0	2	20	2.2
Blackbird	4	5	20	4.5	4	16	4.9	0	0	0	9	36	4.2
Thrush sp.	4	4	16	3.6	13	52	15.9	2	8	9.3	19	76	8.8
House-sparrow	1.25	16	20	4.5	20	25	7.6	1	1.25	1.5	37	46	5.4
Starling	4	3	12	2.7	7	28	8.6	0	0	0	10	40	4.7
Starling or thrush	4	2	8	1.8	2	8	2.4	0	0	0	4	16	1.9
Jay	9	1	9	2.0	0	0	0	0	0	0	1	9	1.1
Jackdaw	8	1	8	1.8	0	0	0	1	8	9.3	2	16	1.9
Small bird	1	7	7	1.6	9	9	2.7	2	2	2.3	18	18	2.1
AMPHIBIANS													
Frog*	1	91	91	20.4	25	25	7.6	17	17	19.8	133	133	15.5
Total			445.5	100		327	99.8		86	100.2		858.5	99.8
Beetles (see Table 5)		10			6			5				21	
Fibre pellets		14			17			10			41		

C.F.=Conversion Factor. *See Table 4.

TABLE 2 Vertebrate and insect prey of tawny owls in Richmond Park, 1966-1969.

	C.F.	*Jan.-Mar.*			*Apr.-Jun.*			*Jul.-Sep.*			*Oct.-Dec.*			*Total*		
MAMMALS		items	units	%	items	units	%	items	units	%	items	units	%	items	units	%
Common shrew	0.5	0	0	0	0	0	0	0	0	0	1	0.5	2.1	1	0.5	0.2
Rabbit	10	0	0	0	12	120	51.9	1	10	34.5	1	10	42.5	14	140	45.3
Bank-vole	1	0	0	0	4	4	1.7	0	0	0	1	1	4.3	5	5	1.6
Field-vole	1	5	5	19.2	25	25	10.8	0	0	0	2	2	8.5	32	32	10.4
Wood-mouse	1	6	6	23	6	6	2.6	0	0	0	5	5	21.3	17	17	5.5
House-mouse	1	0	0	0	1	1	0.4	0	0	0	0	0	0	1	1	0.3
Small mammal	1	1	1	3.8	0	0	0	0	0	0	0	0	0	1	1	0.3
BIRDS																
Kestrel	10	0	0	0	0	0	0	1	10	34.5	0	0	0	1	10	3.2
Stock dove	10	0	0	0	1	10	4.3	0	0	0	0	0	0	1	10	3.2
Thrush sp.	4	0	0	0	4	16	6.9	0	0	0	1	4	17	5	20	6.4
House-sparrow	1.25	0	0	0	5	6.25	2.7	0	0	0	0	0	0	5	6.25	2.0
Starling	4	1	4	15.4	8	32	13.8	0	0	0	0	0	0	9	36	11.7
Crow sp.	8	1	8	30.8	0	0	0	1	8	27.6	0	0	0	2	16	5.2
Small bird	1	2	2	7.6	2	2	0.9	1	1	3.4	1	1	4.3	6	6	1.9
AMPHIBIANS																
Frog*	1	0	0	0	9	9	3.9	0	0	0	0	0	0	9	9	2.9
Total			26	99.8		231.25	99.9		29	100		23.5	100		309.75	100.1
Beetles, etc.†		185			544			0			81			811		
Fibre pellets		1			7			0			0			8		

C.F. = Conversion Factor. *See Table 4. †See Table 5.

TABLE 3 Vertebrate and insect prey of tawny owls at Esher, 1971-1977.

	C.F.	*Mar.*		*Jun.-Aug.*			*Sep.-Dec.*			*Total*		
MAMMALS		items	units	items	units	%	items	units	%	items	units	%
Common shrew	0.5	0	0	1	0.5	0.2	2	1	0.3	3	1.5	0.3
Bank-vole	1	1	1	1	1	0.4	5	5	1.5	7	7	1.2
Field-vole	1	1	1	8	8	3.4	63	63	18.2	72	72	12.1
Water-vole	5	0	0	0	0	0	5	25	7.2	5	25	4.2
Wood-mouse	1	0	0	2	2	0.9	27	27	7.8	29	29	4.9
Harvest-mouse	0.5	0	0	0	0	0	1	0.5	0.1	1	0.5	0.08
Brown rat	5	0	0	1	5	2.1	12	60	17.3	13	65	10.9
Small rodent	1	0	0	2	2	0.9	0	0	0	2	2	0.3
BIRDS												
Woodpigeon	15	1	15	0	0	0	0	0	0	1	15	2.5
Feral pigeon	10	0	0	4	40	17	1	10	2.9	5	50	8.4
Thrush sp.	4	0	0	14	56	23.9	4	16	4.6	18	72	12.0
Greenfinch	1.25	0	0	1	1.25	0.5	0	0	0	1	1.25	0.2
House-sparrow	1.25	0	0	38	47.5	20.3	36	45	13.0	74	92.5	15.4
Starling	4	0	0	6	24	10.3	1	4	1.2	7	28	4.7
Small bird	1	1	1	21	21	9.0	8	8	2.3	30	30	5.0
AMPHIBIANS												
Frog*	1	0	0	26	26	11.1	65	65	18.8	91	91	15.2
FISH												
Goldfish	2	0	0	0	0	0	8	16	4.6	8	16	2.7
Total					234	100.0		346	99.8		598	100.1
Beetles etc. (see Table 5)				19			10					
Fibre pellets				22			17					

C.F. = Conversion Factor. *See Table 4.

Isabella Plantations with two pools and a stream, and Spankers Hill Wood, that is plantations and oakwood surrounded by open oak parkland. Some of the earlier results have been indicated by Beven (1967). The vertebrate food is shown in Table 2 and beetles are studied further in Table 5.

c) Esher, Surrey

The pellets were found within ½ mile of the railway station. Esher is here a built up suburb on the outskirts of London, 15 miles from St. Paul's. The owls were able to visit gardens, some of which have small ponds. There are also some small open spaces and the River Ember is within ½ mile to the north. Pellets were collected from 1971 to 1977 below various trees in the roads, where owls were roosting. Table 3 shows the vertebrate food and the frogs and beetles are shown in more detail in Tables 4 and 5 respectively.

There are very few house mice in these samples of pellets but it is important to appreciate that not only were there 19 (3%) in pellets in Holland Park and 12 (3%) at Morden (Beven 1965), but between 1965 and 1974 some pellets were found at owl roosts in Eastern Wood, within 570 yards of a row of houses and gardens at the edge of Bookham Common. These pellets contained bones of 17 vertebrate species including 28 house mice (17.6%).

Conclusions

1 At Hampstead Heath mammals (of 9 species) were taken more frequently in winter with birds increasing in summer and autumn. Frogs were found in a significant proportion of the diet, *i.e.* 133 (15.5%). Grey squirrels appear to be rather rarely taken by the owl.

2 At Richmond park only six species of mammals were caught, but the owls fed extensivley on rabbits (45.3%). While watchng for these at a warren they took a great many of the dung beetle *Typhaeus typhoeus* which were, no doubt, rolling and burying the rabbits' dung in order to place an egg beside it in their burrow. A kestrel's remains were also found in a pellet.

3 Seven species of mammals were taken at Esher, including one harvest mouse. Eight goldfish were found in the pellets, presumably taken from garden ponds.

4 The owls took 91 frogs (15.2%) at Esher and 133 (15.5%) at Hampstead Heath (Table 4). During March and April frogs are on the move to their breeding ponds, but the peak of numbers from August to November are not so easily explained. During mild winters frogs may not hibernate continuously, appearing on mild days and disappearing on cold ones (Smith 1951). Similar results were reported by Fairley and Clark (1972), who in 1970-71 found frogs in the pellets of barn owls *Tyto alba* in every month of the year except February, June and July in Co. Galway, Eire.

5 Thus where there are very few mammals the tawny owl is able to feed largely on birds, as was shown by Beven (1965). In open spaces in cities they also take a good many birds. This is probably not only because often there are fewer mammals, but also because birds may be easier to catch when they collect in communal roosts *e.g.* on ledges of buildings or in plantations or bushes, where roosting sites are more concentrated and fewer than in woodland.

6 Fibre pellets were found to consist solely of soil, vegetable matter and numerous chaetae of earthworms.

TABLE 4 Monthly totals for frog prey found at Hampstead Heath and Esher.

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun.*
Hampstead Heath	0	3	43	51	4	5
Esher		———	not examined	———		1

	Jul.	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*
Hampstead Heath	3	0	6	9	0	2
Esher	6	19	33	12	19	no data

TABLE 5 Beetles and wasps from pellets of tawny owls at Hampstead Heath, Richmond Park and Esher.

	Hampstead Heath	Richmond Park	Esher
BEETLES			
Carabus violaceus	1	1	0
Carabus nemoralis	0	1	0
Carabus sp.	0	1	0
Leistus spinibarbis	0	0	4
Nebria brevicollis	2	0	0
Pterostichus madidus	2	0	3
Pterostichus melanarius	0	0	2
Pterostichus nigrita	0	0	1
Pterostichus sp.	1	2	2
Staphylinus ?ater	1	0	0
Lucanus cervus	0	0	8
Dorcus parallelipipedus	0	0	1
Typhaeus typhoeus	2	808	0
Geotrupes stercorarius	0	1	0
Geotrupes sp.	0	0	2
Melolontha melolontha	1	0	4
Agriotes ?lineatus	0	0	1
Agriotes sp.	1	0	0
Abax parallelepipedus	1	1	1
Cylindronotus laevioctostriatus	1	0	0
Strophosomus sus	1	0	0
WASPS			
Vespula vulgaris	1	0	0
Wasp sp.	0	0	1

TABLE 6 Summary of prey taken by tawny owls. From the present survey and from Beven (1965)

	Hampstead Heath	Richmond Park	Esher	Holland Park	Bookham Common	Morden
Miles from St. Paul's	5	10	15	4	20	10
No. of mammal species	9	6	7	3	11	4
Mammals	48.5%	63.6%	34%	7%	90%	55%
Birds	35.8%	33.6%	48.2%	93%	10%	45%
Frogs/Fish	15.5%	2.9%	17.9%	——	——	0

Prey of the tawny owl mentioned in the text

Mole *Talpa europaea*, common shrew *Sorex araneus*, rabbit *Oryctolagus cuniculus*, grey squirrel *Sciurus carolinensis*, bank-vole *Clethrionomys glareolus*, field or short-tailed vole *Microtus agrestis*, water-vole *Arvicola terrestris*, wood-mouse *Apodemus sylvaticus*, harvest-mouse *Micromys minutus*, house-mouse *Mus musculus*, brown rat *Rattus norvegicus*.

Kestrel *Falco tinnunculus* woodpigeon *Columba palumbus*, stock dove *C. oenas*, feral pigeon *C. livia*, blackbird *Turdus merula*, thrush *Turdus* sp., greenfinch *Carduelis chloris*, house-sparrow *Passer domesticus*, starling *Sturnus vulgaris*, jay *Garrulus glandarius*, jackdaw *Corvus monedula*, crow *Corvus* sp.

Frog *Rana temporaria*, goldfish *Carassius auratus*.

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I am very grateful to the late Kenneth C. Side, F.R.E.S. for taking a great deal of trouble in identifying the beetles, often from very small portions and also to the late H. G. Denvil who gave me similar expert advice. I am also most grateful to all those who have searched so carefully and labelled the site for the owl pellets, and the staff of the British Museum (Natural History), particularly J. Cooper, Dr G. B. Corbet, G. S. Cowles, C. A. Walker and Alwyne Wheeler, who have helped greatly with their expert advice.

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Book Review

Wildlife and nature photography. By Michael Freeman; consultant Nigel Sitwell. 224pp. Croom Helm, London, 1981. £13.95.

Too many books claiming to be treatises on photography are little more than collections of the author's best work with a necessary minimum of linking text. This one at least endeavours to treat all aspects of the subject, from stalking and hides to studio micro-photography, with the consequences that much of the advice on technique is a re-statement of the obvious, and that some specialities, such as minerals and rocks, are included although they appear to be outside the author's personal experienee. It is agreeable to observe his awareness that a large assortment of equipment can be a burden both to the pocket and in the rucksack; the assumption in books of this sort has to be that there are people who are going to eonsider spending a lot of money on eameras and accessories yet need quite elementary guidance what to do with them. He is also aware that the disturbance photographers cause to animal life can damage the very nature which they seek to record, but needs to be told that the same is true of plant life: he advocates tidying up the vegetation wherc necessary to producc a clear view of the flower in the frame, and neglects to point out that the viewfinder of a camera mounted upside-down on the reversed centre column of a tripod can only be used by a photographer lying on the ground. Surprisingly in a book making a scrious attempt to be comprehensive, plants are considered only in terms of whole trees, bark (illustrated in black and white) and flowers; there is nothing about sueh problems as framing whole herbaceous plants, rendering the tint and texture of foliage, the importance of correct colours in portraits of fungi or the microphotography of moss capsulcs.

R. M. BURTON

Survey of Bookham Common:

FORTIETH YEAR

Progress Report for 1981

General (G. Beven*)

At the fortieth year it is perhaps appropriate that we should pause and consider where the survey is leading us. Amateur naturalists take longer than professionals to carry out a survey, and various specialists may not be available at the same time. But surveys, on the other hand, enable naturalists to see perhaps greater changes occurring in the habitats. There were those occurring as a result of cessation of grazing, and the natural changes towards climax oakwood, but now there are also those associated with conservation management and perhaps leading directly or indirectly to changes in status of various species. Natural history is never static, especially in an area subjected to management, and it will be interesting to see what changes occur and why. Although 85 'papers' have already been published, there are still various groups not yet written up. As long as members are an interested and enthusiastic group, the survey should continue. In many respects the longer the survey goes on, the greater will be the interest.

About 40 members of the Epsom and Ewell National Trust were shown the more interesting features of the Common in April. Tea was available for all, the few cups being washed as needed.

The Institute of Biology organised an exhibition at the Natural History Museum in July, at which the L.N.H.S. demonstrated its activities at an exhibit, about 25% of which was contributed by the Bookham Common Survey team. A new member was recruited there.

Vegetation (Bryan Radcliffe†)

Veronica Pilcher has kindly undertaken the task of building up a herbarium of vascular plants occurring on the Common. This will afford evidence of the present state of the flora, and may be of significance to future workers. Every precaution will be observed to ensure that the collection of material will not lead to depletion of the rarities.

Noteworthy finds of the year include *Sorbus intermedia*, a very small sapling close to a minor path, seen by Ian Swinney: another location for *Polystichum setiferum* by Joan Stoddart: *Clematis vitalba*, a surprising immigrant to this non-calcareous area: *Lemna gibba* in Sheepbell and Bayfield Ponds (John Bratton) and *Lemna minuscula*, only recently recognised in Surrey, in South-East Pond (Joyce Smith). [See comment regarding *L. minuscula* on p.100. Ed.]

Two further specimens of *Rhamnus catharticus* (see *Lond. Nat.* 1981, **60:** 64) have been found. The first, in division Q is about 200m north of the next nearest individual and is probably of the dioecious form. Fruit was almost, but not completely, absent. The most recent specimen, found too late in the season for its form to be assessed is in mature scrub about 40m north of Bookham Station.

The broad gash right across the Common, left bare of vegetation after

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excavations for the pipeline, is regenerating rapidly in some parts, slowly in others. Study is in hand under the direction of Ken Page. Vegetational changes in the recently re-established East and West Hollow Ponds are being investigated by Christine Hibbert and Pat Verrall.

Fungi (E. M. Hillman‡)

The following fungi were collected on the Common on 11 October 1981 and were identified by Peter Holland at an informal meeting of the Botany Section the following day; these six species have not been previously recorded by the Survey:

Auricularia mesenterica	*Mycena alcalina*
Dialonectria peziza	*Pleurotus ulmarius*
Langermannia gigantea	*Polyporus varius*

In addition, there were nine species which have not been recorded since 1947, and are not among P. C. Holland's as yet unpublished records.

Bryophytes (R. C. Stern§)

Oliver French and Ella Hillman have continued to record on the Commons. The following mosses are new to the Commons or have been rediscovered for the first time since before 1967. The habitats are as given in Ella Hillman's paper in *Lond. Nat.* **54:** 49-58 (1975) and nomenclature follows the *Census Catalogue of British Mosses* by E. F. Warburg (1963):

	Area	*Habitat*	*Remarks*
Sphagnum subsecundum var. *auriculatum* (Schimp.) Lindb.	T	1b	
Polytrichum commune Hedw.	T	1b	New record.
Barbula convoluta Hedw.	N	2a	
Bryum klinggraefii Schimp.	N	6b	New record.
Cirriphyllum piliferum (Hedw.) Grout.	O	6b	
Eurhynchium striatum (Hedw.) Schimp.	P	6b	

No liverworts new to the Commons were found.

Although it is hoped that recording will continue, the bryophyte flora is being completed with the position as at 31 December 1981. As the writer finds it increasingly difficult to visit the Commons, he is handing over recording to Oliver French, who has also commenced a comprehensive study of the epiphytic bryophytes on the Commons.

Butterflies (G. Beven)

Pearl-bordered fritillaries were seen on 29 March and 12 June. A male purple emperor fed on dried dog excrement on 12 July (Ella M. Hillman). Essex skippers were observed on 15 August (P. W. King).

Reptiles (G. Beven)

'Records of the slow-worm *Anguis fragilis* are few and scattered, but it is probably widely distributed' (Panchen 1951). Records are still few and scattered, and since 1950 there have been only 16 records of slow-worms, found in sq. 42, 52, 57, 59, 67, 84, 85, 87, 88 and 94. They occurred between late-March and mid-September, most frequently during March-May when they are more active by day, and from July onwards when pregnant females may bask in the sun (Smith 1951), as for example when a pregnant female was seen sunning itself on an elm

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log, ref. 885, on 10 July 1981. In 1969 one was noted with seven young in sq. 87. At most times however, they are mainly nocturnal and are less likely to be seen.

The viviparous lizard *Licerta vivipara* 'although probably distributed over all open parts of the Common is only recorded from the southern half and especially near the station' (Panchen 1951). There are still very few records and these are from sq. 44, 58, 85 and 88. They still occcur however, a young dark one was seen at ref. 883 on 24 August 1981. (P. W. King).

The grass snake *Natrix natrix* is still fairly common in grassland, shrub and woodland (Panchen 1951, Beven 1968).

The adder *Vipera beris* had apparently never been recorded when A. L. Panchen published his paper in 1951, although he thought it might be expected to live in the drier bracken-covered plains. Indeed on 23 May 1954 one was seen on the south side of the Isle of Wight Pond by Leslie Baker and B. A. Richards. There are other records by unknown observers. In 1973 a dog was reported to have died after being bitten by an adder, and also two adders were seen in Hollow Wood by a lady who saw another one near Station Copse in 1975. Also in 1975 Miss Jordan saw one near Upper Eastern Pond and again in ref. 679. In May 1968 Michael Thraves saw one swimming in the Isle of Wight Pond. It is not always appreciated that adders are good swimmers when in pursuit of their prey. They will also swim from one island to another in Scottish lochs (Smith 1951).

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Birds (G. Beven).

Population Studies in Oakwood

The breeding season census was repeated in the 16-hectare sample of dense pedunculate oakwood in 1981, chiefly by Andrew Merritt. In 1977, 1978, 1979 and 1981 the wren territories were 23, 33, 18 and 21, the blackbird 11, 11, 13 and 20, and the robin 34, 40, 41 and 28 respectively. Thus the wren population has remained fairly low, while the blackbirds have increased markedly, and the robins have decreased. Great tits have increased, the figures for the same years being 14, 13, 16 and 23, but the number of blue tits showed little change.

Population Studies in Scrub and Grassland

The breeding season census was repeated in 39 hectares fo scrub and grassland in 1981 by D. A. Boyd and W. D. Melluish. The number of territories for 1978, 1979, 1980 and 1981 respectively was, for wrens 26, 18, 10 and 17, and for robins 30, 40, 33 and 20. Thus, the number of wrens has increased again but of robins has decreased as in oakwood. Blackbirds were still numerous, the figures for 1978, 1979, 1980 and 1981 were 22, 21, 27 and 25.

Other Notes on the Birds

Little grebes again visited Lower Eastern Pond and Canada geese again nested on the Isle of Wight Pond. A pair of tufted ducks was on Eastern Hollow Pond on 7 May. On Western Plain a Cetti's warbler was heard in song on 12 July (Ella M. Hillman).

The Status of the Magpie and its Possible Effect on the Numbers of Small Birds

In some areas of Britain magpies *Pica pica* have recently increased in numbers, especially in cities and suburbs (Montier 1977). There seems to be a general impression that a similar increase has occurred at Bookham Common and they have been blamed for a decrease in the population of small birds. In 1943 the magpie was reported as 'not by any means a common species' (Carrington *et al.* 1944), so that gatherings of up to 30 birds on the scrub and grassland in early 1976, seemed to confirm the impression of increase. However, parties of between 20 and 39 magpies were seen to assemble before going to roost in a wood just outside the Common between December 1953 and April 1954. These birds are unlikely to have all come from the Common.

Although a conspicuous bird, the magpie is difficult to census accurately and even fairly reliable figures are probably available only for the last 12 years or so. Census figures for the territories of magpies and small birds (averaged over three years) are compared below. Small birds include all the passerines breeding there, except members of the crow family.

Average number of territories of		*1. Magpies*	*2. Small birds*
39 ha. of scrub and grassland	1967-1969	4	201
39 ha. of scrub and grassland	1976-1978	6	252
16 ha. of oakwood	1968-1970	2	174
16 ha. of oakwood	1976-1978	2	154

In scrub and grassland over the periods shown, there was an increase of small bird territories in spite of an increase of magpies, while in oakwood there was a slight decrease of small bird territories, with no change in the numbers of magpies. Thus there is no evidence that magpies have increased in the oakwood and the increase in scrub and grassland is only very small, as most of the scrub and grassland areas are covered by the census. No doubt many factors are involved, but there is no clear evidence of a great increase in the numbers of magpies. There is a slight decrease in the numbers of small birds in oakwood, but there is no reason to suggest it is due to magpies, an opinion shared by Tatner (1980).

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Mammals (G. Beven)

On 10 July juvenile common shrews were abundant in and around Station Copse, but no water shrews were found. However, on 9 August there was a large influx of water shrews which then outnumbered the common shrews there (Peter W. King). Roe deer were seen frequently.

Platyhelminthes; Turbellaria; Tricladida (J. H. Bratton*)

Species of triclad (flatworm) recorded from the ponds of Bookham Common are given below, together with the dates they were collected.

S.E. Pond: *Dugesia tigrina* (Girard) 26.7.81, 9.8.81, 1.11.81.
Upper Eastern Pond: *Polycelis nigra* (Müller) 9.8.81, 13.9.81.
P. tenuis Ijima 13.9.81.

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Lower Eastern Pond: *Polycelis nigra* (Müller) 9.8.81, 13.9.81.
P. tenuis Ijima 13.9.81.
Polycelis sp. 1.11.81.
Dugesia polychroa (Schmidt) 9.8.81, 13.9.81, 1.11.81.
Dendrocoelum lacteum (Müller) 1.11.81.
East Hollow: *Dugesia tigrina* (Girard) 9.8.81.
Sheepbell Pond: *Dendrocoelum lacteum* (Müller) 9.8.81, 1.11.81.

This species list is only one short of half the British total for freshwater triclads, and two further species are likely to be present in the running water on the common.

Over one hundred specimens of *Polycelis* spp. were obtained from Lower Eastern Pond on 13 September 1981 by baiting with a piece of raw liver for two hours. The two species appear to be fairly equally abundant. Of nine positively identified by squashing (Reynoldson 1978), six were *P. nigra*, three were *P. tenuis*. Large numbers of *Dugesia polychroa* were also attracted to the liver.

REFERENCE

REYNOLDSON, T. B. 1978. A key to the British species of freshwater triclads. *Scient. Publs Freshwat. biol. Ass.* **23:** 32pp.

Annelida; Hirudinea (J. H. Bratton)

Freshwater leeches found in 1981 are listed below, with dates:

Lower Eastern Pond: *Theromyzon tessulatum* (O. F. Müller) 9.8.81.
Upper Eastern Pond: *Helobdella stagnalis* (L.) 1.11.81.
East Hollow: *Theromyzon tessulatum* (O. F. Müller) 1.11.81.
West Hollow: *Piscicola geometra* (L.) 1.11.81.
Theromyzon tessulatum (O. F. Müller) 1.11.81
Helobdella stagnalis (L.) 1.11.81.
Erpobdella octoculata (L.) 1.11.81.

Arachnida; Hydracarina (J. H. Bratton)

The following water mites were collected from the common on the dates shown:

S.E. Pond: *Piona carnea* (Koch) 12.7.81.
West Hollow: *Hydrodroma despiciens* (Müller) 26.7.81.

The identification of the specimens was kindly checked by Mr. T. Gledhill of the Freshwater Biological Association.

Book Review

ECOS — A Review of Conservation. The Journal of the British Association of Nature Conservationists.

ECOS, produced by the friendly high street conservation organisation BANC (the British Association of Nature Conservationists), is intended to review the aims and development of conservation by encouraging critical discussion, the provision of information, ideas, news and current events. This review issue, volume 2, part 3, does just that, with a wide cross-section of contributions covering practical subjects such as oil and birds, spray drift problems, cross country vehicles and nature conservation to the more erudite and philosophical considerations of The Magic of Landscape and The Purpose of Nature Conservation. All this and more, is well laid out in an easily stored A5 format.

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SUSAN JOY

Botanical Records for 1981

by R. M. Burton*

Summary

Principal botanical discoveries in the London area in 1981 include *Parentucellia viscosa* and *Trachelium caeruleum* in Kent, *Sagina nodosa* in a new locality and *Triglochin maritima* in an old one in Surrey, *Saxifraga granulata* and *Vicia lutea* in S. Essex, *Rosa stylosa* in N. Essex, *Cardamine amara* and *Lathyrus tuberosus* in Herts, *Crassula helmsii* and *Hypericum maculatum* in Middlesex and *Littorella uniflora* re-discovered in Bucks.

Introduction

The year may have been dull in the meteorological sense but botanically it was as exciting as any in the study of the area within 32km of St. Paul's Cathedral. Many extremely interesting notes and lists reached me as the London Natural History Society's recorder for vascular plants and it must be emphasised that only a small selection of their contents can be included here. Also the geographical information is presented in the standardised form of a tetrad number, using the system described by Sandford (1972), which places each record in a square area bounded by even-numbered kilometre lines of the National Grid, whereas the permanent records kept on a card index include much greater detail whenever members have been kind enough to supply it.

During 1981 a number of records of an alien duckweed *Lemna minuscula* Herter have been made west of London in Herts and Middlesex. There is an earlier record from Harlow, N. Essex and elsewhere in this issue of *The London Naturalist* (p.95) it is reported from Bookham Common, though the finder has since expressed doubt and asks for the report to be disregarded. Details of all the correct records and a description of the plant, which is not unlike *L. minor* but smaller and of a different shape, are given in a paper by A. C. Leslie and S. M. Walters to be published shortly in *Watsonia*, so are not repeated here. The 1981 tetrad distribution is 06T86 07T22 09T64 09T84 09T86 16T48 16T68, but as the plant appears to have been present undetected for some time it will not be surprising if it turns out to be more widespread. Searchers for it are recommended to keep an eye open for the even smaller *Wolffia arrhiza* which used to be in similar places near the Thames above London but has not been seen there for more than 40 years.

Records

V.C. 16, West Kent

Continuing the pattern established over several years past, the most remarkable plants in our part of Kent have been those found by J. R. Palmer. In Joydens Wood (47T80) he and E. G. Philp came across a colony of 40 plants of the yellow bartsia *Parentucellia viscosa*. This is a well-explored wood and it is likely that this conspicuous flower is a new arrival but it does not seem to have been brought in by any of the known means by which plants are accidentally introduced. The few previous occurrences of the species in the London area have all been of the same mysterious character, appearing as from nowhere in some quantity (and dwindling back to nothing in a few years). Also in Joydens Wood were *Stellaria pallida* (47T82) and *Quercus borealis* well on the way to becoming extensively naturalised. On a wall at Bexley (57T04) Mr Palmer found *Trachelium caeruleum*,

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a plant somewhat similar in general habit to *Centranthus ruber* though the appearance of the individual small flowers and fruit betrays the relationship with *Campanula*. This was originally an escape from cultivation nearby, cultivation which has now ceased. *Trachelium caeruleum* has long been known in a similar situation in Guernsey, where it is now naturalised in four places (McClintock 1975:190) but has not previously been seen naturalised in Britain. It is native in the west Mediterranean region. At Northfleet (67T20) he found large quantities of *Petroselinum crispum* in a roadside shrubbery, seedling *Pyracantha coccinea* in a similar place and *Xanthium spinosum* in cabbage fields. Near large salt heaps at Pepper Hill (67T22) he found *Puccinellia distans* and *P. fasciculata*. Badmin (1980,1981) has traced the first of these salt-marsh grasses along main roads in Kent where the use of salt on snowy roads is allowing it to spread, but makes no mention of *P. fasciculata* in similar situations. Mr Palmer's interest in alien plants takes him to such places as an industrial dump at Greenhithe (57T84) which in 1981 had a good quantity of the true castor-oil plant *Ricinus communis*, the grass *Brachiaria platyphylla* and a good patch of *Ligularia clivorum*, a tall garden plant with very large leaves and flowerheads like those of a *Senecio*. He also led our meeting of 27 June which was unfortunately just too late to see *Iris xiphioides* and *I. xiphium* var. *lusitanica* before they were cut down with the hay in a field at Fawkham (56T88). An arable field across the valley produced *Legousia hybrida* and *Viola tricolor*, both rare weeds nowadays, and the small area of downland south of Longfield Station (66T08) has abundant *Genista tinctoria* and some good chalk plants. However, there was no sign of the *Sanguisorba officinalis* and *Filipendula vulgaris* reported here in 1969 by P. C. Hall. The latter plant is locally common on the chalk in Surrey but we had no other recent record of it in Kent until it was found in 1981 by H. Cox at Kemsing Down Nature Reserve (55T48) on a spot which had recently been cleared of scrub growth.

I learnt of this last from Mrs J. Pitt who also passed on to me records of other members of the Orpington Field Club along with her own, such as Mrs S. Pittman's thousands of bee orchids *Ophyrys apifera* in a derelict orchard at Crockenhill (56T06) and *Lathyrus aphaca* in the same area and W. Whitaker's *Dactylorhiza praetermissa* in damp hollows on Biggin Hill airfield (46T20). Most of her own best finds are those from Jubilee Park, Petts Wood (46T28), and area only recently, as the name implies, made accessible to the public. The last time botanical records were made there it was the West Kent Golf Club, which was where the rare umbellifer *Oenanthe pimpinelloides* was found in the vice-county by R. W. Hale in 1943 (Lousley 1944:9). The plant is still there in quantity in meadows on heavy clay. Jubilee Park also contains a patch of the pebbly Blackheath Beds, and in grassland here Mrs Pitt found *Trifolium ornithopodioides*, *T. striatum*, *T. subterraneum* and commoner plants of the habitat. The park also contains oakwood with *Melampyrum pratense* and a hedge with two plants of *Pimpinella major*. Near St. Mary Cray (46T86) she found two trees in a hedgerow which were identified at Kew as *Crataegus sub-mollis* and the Californian poppy *Eschscholzia douglasii* as an abundant weed in a cabbage field. She also conducted a survey of parts of Crayford Marshes which are the subject of a development proposal. Certainly the most important discovery here was *Ranunculus baudotii* in some of the ditches (57T26): this used to grow nearby but is not known now anywhere else in Greater London. I paid a visit myself to the area earlier in the year, when *R. aquatilis* was flowering in a moat (57T26) and *Cerastium semidecandrum* was unexpectedly abundant in some places on the river walls of the Cray and Thames (57T24 and T26).

Dr G. S. Joyce found *Campanula medium, C. persicifolia, C. rapunculoides* and a form of *Vicia villosa* together on waste ground near Swanley (56T26), which must have been a pretty sight. Miss E. M. Hillman reported *Hypericum montanum* at High Elms (46T42) and a small patch of *Montia sibirica* near the boundary of Hayes Common (46T04). She also showed me a plant of *Duchesnea indica* found unasked-for in his garden at Chislehurst (47T20) by F. Willmot; this species looks very like a strawberry in fruit and runs just as quickly but the flowers have yellow petals and the 'berries' are inedible.

V.C.17, Surrey

Most local floras describing areas where *Sagina nodosa* grows state that it is an inhabitant of damp sandy ground with rather scanty vegetation, but for some decades it has been known in the London area only from Banstead Downs (26T40) where it was first found by E. C. de Crespigny in 1882 and was re-discovered after a long interval by R. C. Wingfield in 1957 (Lousley 1958:183). In 1981 Miss Hillman found it on Park Downs (25T68) where it was previously known only to C. E. Salmon (1931:190) and B. R. Radcliffe counted 15 plants on Epsom Downs (25T28). In all three localities it is in short turf on shallow soil over chalk, near a path. Mr Radcliffe very reasonably suggests some connection with the exercising of horses on the downs. In woodland on Park Downs he and K. Page saw a single plant of *Helleborous foetidus.* On Walton Common (06T84) both saw *Iris sibirica, Tradescantia virginiana* and, independently of each other on successive days, *Lathyrus aphaca.* Mr Radcliffe found two plants of *Rosa stylosa* on Epsom Downs golf course (25T28) and there appear to be many hybrids with dog roses nearby. He also passed on to me various interesting discoveries made by others, such as Mr Page's *Scrophularia vernalis* in a ditch by Ham Moor (06T64) and Mr Page and A. C. Leslie's four plants of *Euphorbia platyphyllos* in the same area at the edge of ground disturbed by tipping of rubbish.

Mr Radcliffe was also an occasional member of a group which fairly regularly included Dr Leslie, Mr Page and Miss J. M. Stoddart, to whom I am indebted for an account of their finds. Quite the most remarkable of these were small quantities of *Carex divisa* and *Triglochin maritima* by the tidal Thames between Putney and Hammersmith Bridges (17T26). The sedge had been seen at intervals at this spot up to 1962 (Lousley 1976:341). Also present were a small stand of *Scirpus maritimus,* a well-grown self-sown fig tree *Ficus carica,* etc. Above Kew Bridge, almost out of reach in the river (17T86), there was *Poa palustris.* They found *Lathyrus aphaca* on one of the hills formed by dumping soil when the road was widened on Putney Heath (27T22); near these hills were eight or nine spikes of *Epipactis helleborine,* first found by Miss J. Roberts. Miss Stoddart alone noticed *Ranunculus sardous* on lawns near County Hall (37T08), confirmed by Dr Leslie. There were about a hundred plants. It may be supposed that seed was introduced when the turf was laid about 27 years earlier, and either it lay dormant or the plant had flourished unnoticed since.

The name of Rupert Hastings has been known some while in the Society's ornithological circles but has not been seen before in its botanical reports. The first records he submitted were those for 1979 and 1980, received too late for mention here a year ago, a pity as they included a number of plants of *Aster tripolium* in the drained north-west basin of Barn Elms Reservoir (27T26). The sea aster is a very rare plant in Surrey. The basin has since been re-filled, but others of his 1980 records could be repeated in 1981, including *Sisymbrium loeselii* near the Public Record Office, Kew (17T86), *Rumex pulcher* on Kew Green (do.)

where it gets cut by mowing machines, *Medicago falcata* on Barnes Common (27T26) and a number of rare and local species growing naturally in Kew Gardens where he is employed in the Museums Division. In 1981 he added to these; all his Kew plants have been reported in print before at some time except, I think, for the alien *Pratia angulata*, well established on the lawn in Cambridge Cottage garden (17T86), although this is well known to some members of staff. Other plants which are not new but which it is very pleasing to learn are still present include *Barbarea stricta* between Kew and Richmond in two places (17T64 and T66), a large population of *Cardamine amara* near the south end of Kew Gardens (17T66) where it was evidently not eliminated by a flood tide in 1949 as stated by Lousley (1976:126) and several species from the gravelly area now known as Ham River Lands (17T60 and T62), including *Cerastium arvense, Filipendula vulgaris, Lathyrus aphaca, L. hirsutus, Lepidium latifolium, Ophrys apifera, Poterium sanguisorba* and *Verbascum nigrum*, but not *Scilla autumnalis* which I am, however, assured by M. Latto is still present in small numbers. Mr. Hastings reports that *Lathyrus grandiflorus* is still present as a patch 71 feet long near Barn Elms Reservoir (27T26) where it was collected by Mrs L. M. P. Small in 1962 (Lousley 1976:181) and found a large bush and a second smaller plant of *Cytisus multiflorus* on Barnes Common (27T24). In roadside grass by Swanworth Lane, Mickleham (15T62) he photographed a dense group of *Briza maxima*.

In Kew Gardens again, Mr Palmer found *Calceolaria chelidonoides* as a weed near the Australian House (17T86) and elsewhere. As weeds in Dulwich Park (37T22) he found *Myosoton aquaticum, Hypericum humifusum* and other plants probably introduced with peat or some other dressing, and seedlings of *Cotinus coggygria* the smoke tree (it is in fact a shrub) up to 400 metres from the parent bush. In Forest Road, Kew (17T86) I found single plants of *Allium triquetrum* and *Geranium lucidum* as street weeds. Mrs E. Norman reports *Smyrnium olusatrum* from Kew Green and *Carex divulsa* from the tow-path nearby. J. Latham saw *Inula conyza, Doronicum pardalianches* and *Valerianella ?locusta* on the steep stone bank of a reservoir near Lonsdale Road, Barnes (27T06). Melinda Hutchinson told me about three plants of twayblade *Listera ovata* which had appeared in a Wimbledon churchyard (27T40).

V.C. 18, South Essex

Two 1980 records deserve mention first. In the churchyard at West Thurrock (57T86) J. F. Skinner and R. G. Payne found a very large number of plants of *Saxifraga granulata*. Although known in several similar localities not far away in Kent, the meadow saxifrage is a great rarity across the Thames. *Erodium cicutarium* and *Salvia horminoides* were also present. At the edge of a playing field north of Pyrles Lane, Loughton (49T26) K. J. Adams found *Rorippa austriaca* in a new locality most probably connected in some way with the long established one near the River Roding at Chigwell. In 1981 Dr Adams found *Hydrocharis morsus-ranae* in Fairmead Bottom ponds (49T06), *Lathyrus sylvestris*, another rarity in Essex, in Dagnam Park (59T42) and *Myriophyllum verticillatum* in Epping Forest ponds south-west of Wake Arms (49T06 and T26). I found the last again, together with *Rumex maritimus*, abundant *Aster tripolium* and *Azolla filiculoides* in a flooded clay pit near Stubbers (58T64) on the occasion of the Society's meeting on 29 August. On that day Dr Adams and I together discovered *Euphorbia exigua, Kickxia elatine* and *K. spuria* at the edge of a field on boulder clay south of Mores Wood, Bentley (59T46). This wood has received much attention from students at Queen Mary College which has a field station nearby, but has seldom been mentioned in our records, although its vegetation

includes such uncommon plants as *Blechnum spicant*, *Iris foetidissima* and *Ruscus aculeatus* (all 59T66).

Ealier in the year, together with Miss C. M. Balfour and B. L. Coombes, Dr Adams and I went to a site near Snaresbrook (38T88) from which there is a record of *Dactylorhiza incarnata* (Jermyn 1974). The plants are unquestionably *D. praetermissa*. Both these species of marsh orchids and hybrids connecting them and the spotted orchid have been reported (Beck 1980) from ground at the Propellants, Explosives and Rocket Motor Establishment near Waltham Abbey (39T88) to which we went next, by arrangement, where we were joined by Dr N. Campbell, Miss M. E. Kennedy and B. Wurzell. All that remains of the original colony, largely shaded out by the development of birch, is a single plant of *D. incarnata*, one which Dr Campbell suggested should be *D. incarnata*×*praetermissa*, a very few *D. praetermissa* and a few unidentifiable seedlings. However, in a different part of the establishment there is a fine colony of *D. praetermissa* in ground kept open and permanently wet by its operations. This orchid was also discovered in reasonable quantity in a new and quite unexpected locality in a different part of S. Essex (48T**) in 1981. Miss Balfour, Miss Kennedy, Mr Wurzell and I also went to Lords Bushes, Buckhurst Hill (49T02), a detached portion of Epping Forest. Hanson (1980) has shown how all aspects of its natural history have become very much more varied and interesting following prolonged burning during the scorching summer of 1976. *Carex binervis*, *C. pilulifera*, *Juncus bulbosus* and *Ornithopus perpusillus* which we found in some quantity were not known there before the fire, but the one plant of *Carex echinata* we saw, partially shaded by a living tree, was such a massive tuft that is must surely have been much more than six years old.

Mr Coombes again sent me a list of his own interesting botanical discoveries. The railway side at Harold Wood (59T40) produced two large colonies of *Valerianella locusta* and *Ophioglossum vulgatum* abundant in a burned area and no doubt less inconspicuous there than it often is. In Knightlands Wood (50T00) he noted scattered *Dactylorhiza fuchsii*, abundant *Euphrasia*, *Lychnis flos-cuculi* and *Orchis mascula*, and alongside the lane *Clinopodium vulgare*. Another locality further south (59T08) has both of the orchids just mentioned in quantity and also a group of ten twayblade *Listera ovata*. *O. mascula* was also abundant in Beachet Wood (40T80). He found abundant *Carex pilulifera* in Thorndon Park (69T00) and *C. nigra* in a marsh near Gilstead Hall (59T44). There was a scattering of *Juncus bulbosus* and *Scirpus setaceus* on a wet slope near Kelvedon Hatch (59T68). The *Scirpus* also appeared during the meeting Mr Coombes led for us in June near Stapleford Tawney in a flushed site in an old pasture (59T08), together with *Briza media* and *Carex panicea*, both very rare plants in this part of our area. On that occasion the unexpected discoveries of one small plant of *Hypericum humifusum* and two large ones of *Vicia lutea* were made on the raw gravel banks of a new reservoir a little to the south.

V.C. 19, North Essex

In a field on Keysers Estate, Nazeing (30T86) Mrs A. M. Boucher found *Euphorbia*×*uralensis* and *Foeniculum vulgare*. In 1977 in Old Nazeing Road (30T66) she collected from the only plant of *Rosa stylosa* reported in the vice-county since the publication of Gibson (1862:108-9).

V.C. 20, Hertfordshire

Mrs Boucher sent me a list of records, made during the last few years, which

adds enormously to our knowledge of the flora of Herts from around Hoddesdon and Broxbourne, west to the neighbourhood of Barnet. A few plants are from adjacent Essex, as already indicated, and Middlesex. Many of them are supported by specimens which have been checked by experts in appropriate cases. They include *Solidago virgaurea* in Cowheath Wood (30T48) in its last surviving Herts locality and *Myriophyllum alterniflorum* in a pond on Barnet Common (29T46), the first record in the county since 1916. The common also has *Apium inundatum* in two ponds and *Juncus bulbosus* and nearby at Monken Hadley introduced *Crassula helmsii* and *Stratiotes aloides* flourish, the latter without blooming. Selecting from Mrs Boucher's long list is difficult but I will mention the following, all seen in 1981: *Thalictrum flavum* and a single *Sanguisorba officinalis* in an old gravel pit at Rye Meads (31T60/T80); *Potentilla anglica* in Barclay Park, Hoddesdon (30T68); *Lathyrus grandiflorus* at Broxbourne Station (30T66); *Ononis spinosa* by the main gate to Haileybury College (31T40); *Genista anglica* at Colney Heath (20T04); and *Bunias orientalis* near a factory at Welwyn Garden City (21T42). Near Fields Lock (30T88) she collected an evening primrose which is very like a plant I collected near Mitcham Junction Station, Surrey in 1979 determined by K. Rostański as '*Oenothera* sp. near *O. parviflora* L., differs in elliptic cauline leaves and punctulation of stem'.

Another list accompanied by useful notes and details was supplied by Dr D. Griffith and indicated some of the rarer plants of the neighbourhood of Totteridge, which is mostly in V.C. 20, though there are often no modern boundaries in that area corresponding to those separating the vice-counties of Watson (1873). Her *Anthyllis vulneraria* near Barnet Lane (29T44) was near to *Onobrychis viciifolia* and *Poterium polygamum* and I suspect that all three came in the same seed mixture. Though obviously planted in one path-side site, in another in the Dollis Valley (29T44) *Montia sibirica* appeared to be naturalised. By Totteridge Lane (29T42/T44) she found *Euphorbia exigua* and *Galium odoratum*.

Mr Hastings sent me a list from disused railway lines beside Croxley Moor 09T84), where A. V. Moon showed him *Echinops sphaerocephalus*, *Sedum telephium* and *Lathyrus tuberosus;* the last is only the second record for Herts. The *Sedum* was also reported by Miss J. Colthup who found *L. sylvestris* on tipped land by a different railway on the far side of the Moor (09T64). A more remarkable find by her perhaps was a single plant of *Saxifraga tridactylites* on an old wall in the centre of Rickmansworth (09T64). By a footpath near Colney Street (10T62), Mrs E. Bowman saw four plants of *Centaurea cyanus* in a field which had been blue with cornflowers 18 years before but had had none when searched for in intervening years. *Crassula helmsii* was also found in a pond at Monken Hadley (29T46) by J. Bratton; the grid reference he gives is so different from Mrs Boucher's that they can hardly intend the same pond. T. Dean showed to an indoor meeting of the Society good voucher photographs of *Cardamine amara* near Stockers Lake (09T42); the last reliable record of this species in Herts was in the same area in 1938.

V.C. 21, Middlesex

With a great many interesting though perhaps not really outstanding records to choose from, it is not easy to decide how to begin this section. Perhaps the best is *Hypericum maculatum* restored to the Middlesex flora by D. Bevan who found it in gardens near Ken Wood (28T66) and Coppetts Wood (29T60), though whether as a relict native or an accidental introduction with horticultural stock it is impossible to say. In a garden lawn at Muswell Hill (28T88) Mr Bevan found

Scirpus setaceus. A plant whose spread is certainly connected with the nursery trade is the North American *Veronica peregrina* which B. Wurzell found in the car park at Syon House (17T66). The first Middlesex record of *Crassula helmsii* was made independently in Pump Pond, Stanmore (19T62) by J. Bratton and Mrs M. V. Marsden. Mr Bratton also found *Lemna gibba* abundantly at Rammey Marsh in the corner of the vice-county (39T68). Mrs Marsden's other finds, numerous as usual, include *Apera spica-venti* near West Drayton (80T60), *Ranunculus lingua* in Harefield Pond (09T40) and *Geranium phaeum* abundant along a footpath near Harrow Park (18T46). She showed me a specimen of *Dipsacus pilosus* collected in Highgate Cemetery (28T86) by Mrs D. Thompson; the interest of this discovery is very much diminished by the information which reached me later that the small teasel is among wild flowers recently sown or planted there. The two ladies together found *Allium paradoxum* typically well established in an alleyway at Brooks Hill, Harrow Weald (19T40), which later had more *Geranium phaeum*.

Cemeteries were also a rewarding hunting ground for J. Latham. Brompton Cemetery (27T46) had *inter alia Mycelis muralis, Erigeron acer, Verbascum nigrum* and naturalised *Campanula trachelium, C. rapunculoides* and *Geranium sanguineum*. Kensal Green Cemetery (28T22), it can be inferred from Mr Latham's lists, has more indications of the nature of the habitat before burials began, notably *Sanguisorba officinalis, Trifolium medium, Primula vulgaris, Ajuga reptans* and abundant *Senecio erucifolius*, together suggesting poorly drained grassland on the London Clay. Aliens are of course far from absent, the best being long-established *Lathyrus grandiflorus*, identified for him by Mr. J. M. Mullin of the British Museum (Natural History).

Early in May I was in a party conducted around Abney Park Cemetery at Stoke Newington (38T26). This appears to be less interesting, but I did see single plants of *Euphorbia amygdaloides* and *Hypericum hirsutum*. Another site I visited which is currently attracting interest is Hounslow Heath which we surveyed briefly in September; a fuller survey of the Heath's natural history is to be conducted in 1982. Although a large area is dominated by weedy plants, relics of natural vegetation remain, notably along the south margin (17T22) where there are *inter alia Molinia caerulea, Ulex minor, Nardus stricta, Genista anglica* (by the railway only), a very pruinose form of *Festuca ovina* and a few plants of *Juncus squarrosus*. These and a few more further north (17T04 or T24) in a large area of almost pure *Nardus* are probably the only plants of the heath rush remaining in Middlesex. An area adjacent to the heath (17T24) but apparently not now considered part of it has more *Nardus* etc., two plants of *Erica cinerea*, the only *Carex pilulifera* seen and other good heath plants. It is to be hoped that it will be possible to include this ground, which is little usesd, in any plans for the safeguarding of Hounslow Heath in the future.

Many recorders already mentioned under other counties also sent me data referring to V.C. 21. Mr Radcliffe found *Scrophularia vernalis* in a shaded ditch at Staines (07T20). Mrs Boucher saw *Geranium lucidum* in a courtyard at Forty Hall (39T28). Dr Leslie *et al.* observed *Carex divulsa* by the canal path near Brentford (17T66) and further north (17T68) *Rumex palustris, R. cristatus* and in a nearby meadow many spotted orchids *Dactylorhiza fuchsii*. Mr Mullin found the alien fern *Pteris tremula* established in a mews area at South Kensington (27T68) which was also seen independently by A. Titcham; this was the first time this species has been seen in Britain out of cultivation. Miss Colthup saw *Borago officinalis* and *Kickxia spuria* on tipped soil by Springwell Lane (09T42). Mr Hastings saw many plants of *Medicago falcata* and *Euphorbia×pseudovirgata* at the farther side of

the vice-county near the William Girling Reservoir (39T64). In a gravel pit near Denham Studios (08T48) he was shown plentiful *Nymphoides peltata.*

V.C. 24, Buckinghamshire

Mrs Marsden confirmed the presence of *Littorella uniflora* in great plently in the lake in Black Park (08T02) as previously reported by Druce (1926:279) but not since by our members. This is still the only locality in our area from which this plant of lake-shores, rare in south-east England, has been recorded correctly. Also present, but much more precariously, is *Scutellaria minor.*

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Book Review

The Oxford Book of Insects. By John Burton. Pocket edition. Pages viii+201 [+12 of index unpaginated]. Stiff paper cover. Oxford University Press. 1981 [on frontispiece but not issued until 4 March 1982]. £2.50

General naturalists as well as entomologists will, I am sure, welcome this third volume in the pocket editions of the larger 'Oxford Book' nature series (the other two already available in the smaller size being those on Birds and Wild Flowers).

The larger edition on insects was first published in 1968 and since then has been reprinted several times. The format of the present volume, reduced approximately by one-third, has lost little in clarity in the process; indeed some of the illustrations seem, if anything, to be brighter and more crisp than their counterparts in the larger volume. It has, of course, necessitated changing each reduction scale from natural size, given at the side of each illustration.

It is impossible in a work of this size to deal with more than a small proportion of the 20,000 or so British insects, but by judicious selection the author has brought together nearly 800 species most likely to be encountered by users of this book. All are illustrated and have text matter on the pages facing the plates. Regarding the text, it is good to see that the author has not been tempted to invent vernacular names (as so many do in such books) for those insects where none in common usage exists. Most of the insects are depicted in natural positions on either flowers, stems or leaves, and your reviewer found those illustrating the beetles (8 plates) and of the grasshoppers and crickets (4 plates) particularly good. The book ends with a short description of insect structure and classification, together with a reading list which is reasonably up to date.

For such a useful, portable volume it is to be highly recommended at the price.

Eric W. Groves

Statement of Affairs

1980				
		Premises and Equipment Fund		
		(incorporating the Hindson and Castell Bequests)		
85,348		Balance at 1 November 1980		82,672
	161	*Add:* Investment deposit interest	93	
	838	National Savings Bank interest	1,812	
	4,646	Investment income received	4,565	
	1,884	Income tax recovered	1,938	
		Profits less losses on sales of		
	(867)	investments	1,692	
	6,662		10,100	
	691	*Less:* Custodian's charges	947	
5,971				9,153
91,319				91,825
	581	*Less:* Grant to General Account	429	
	5,708	Accumulated Fund written off	—	
6,289				429
85,030				91,396
2,358		*Less:* Deficit for year		3,571
82,672				87,825
		Other Funds		
		Library Cataloguing Fund		
	99	Balance at 1 November 1980	99	
		Plant mapping scheme: Research and Publication fund		
	212	Balance at 1 November 1980	212	
311				311
82,983				88,136
		Current liabilities		
	2,700	*London Naturalist* provision	2,900	
	4,800	*London Bird Report* provision	2,900	
	—	Custodian's charges due	945	
7,500				6,745
£90,483				£94,881

at 31 October 1981

1980			
	Assets		
73,579	**Quoted investments** at cost		79,670
	(Market value £106,173)		
	Funds at bank and on deposit		
	National Westminster Bank Ltd.		
214	Current account	347	
3,100	Deposit account	2,500	
150	Investment cash	408	
13,393	National Savings Bank account	11,862	
16,857			15,117
47	**Cash in hand**		94
£90,483			£94,881

Report of the Auditors to the Members of
the London Natural History Society

We have verified the above Statement of Affairs and attached receipts and payments account with the books and accounts of the Society and certify them to be in accordance therewith.

4 London Wall Buildings
London EC2M 5NT.
23 November 1981

FRASER KEEN
Chartered Accountants

General

1980				
		Payments		
513		Hire of halls, etc.		346
567		Lecturers' fees and expenses, Sectional expenses, including L.N.C.C		546
1		Castell Research Centre		7
565		Library		386
16		Equipment repairs and renewals		43
605		*Programme* printing costs		654
355		*Bulletin* and *Newsletter* expenses		341
		Provisions —		
	2,700	*London Naturalist* — **60**	2,900	
	2,700	*London Bird Report* — **45**	2,900	
5,400				5,800
722		Mailing costs (*L.N.* **59**, *L.B.R.* **43** and **44**, *Programmes*, *Bulletins* and *Newsletters* — postage, envelopes, etc.)		1,134
298		Costs of services (Auditor's fees, insurance etc.)		333
405		Honoraria		650
132		Miscellaneous postage and telephone		116
107		Miscellaneous stationery		26
15		Sundries		36
6		*Atlas of Breeding Birds of the London Area* Postage		3
249		Memorial stone for Cyril Castell		—
—		Contributions to other organisations		100
£9,956				£10,521

Account

1980				
		Receipts		
6,062		Subscriptions — current	5,896	
16		arrears	—	
177		in advance	158	
70		entrance fees	64	
6,325				6,118
158		Donations		252
207		Tax recovered from deeds of covenant		219
52		Deposit Account interest		224
	581	Transfer from Premises and Equipment Fund	429	
	19	Sale of surplus library stock	82	
600				511
		London Naturalist **59**		
	2,100	Provision 1980	2,700	
	2,472	Printing and expenses	3,314	
	(372)		(614)	
	71	Sale of offprints	25	
(301)				(589)
		London Bird Report **(43)**		
	—	Provision	2,100	
	—	Printing and expenses	2,550	
—				(450)
		London Bird Report **(44)**		
	—	Provision	2,700	
	—	Printing and expenses	2,725	
—				(25)
	231	Sales of journals	690	
	—	Expenses	94	
231				596
27		Subscriptions to *Bulletin*		26
		Symposium 1980		
	535	Sales of tickets, etc.	232	
	448	*Less:* Hire of halls, fees, etc.	230	
87				2
		Atlas of Breeding Birds of the London Area		
	108	Sales	43	
	104	Royalties	23	
212				66
2,358		Excess of payments over receipts (transferred to Premises and Equipment Fund)		3,571
£9,956				£10,521

Book Reviews

Epsom Common. The Epsom Common Association. Croydon (294 High Street), Living History Publications. Local guide no. 5. 1981. £1.10.

In 64 octavo pages of tiny type, relieved by numerous small drawings, this booklet gives us an introduction and four chapters on the history of Epsom Common by Janet Glover and one each on plants, butterflies, dragonflies and other insects and on birds and other vertebrates by Joan Willett, Harold Gough and Bob Dye respectively. Though a knowledge of the history of the Common is essential to a complete understanding of its present character, its history is not all that different from many others derived from medieval 'wastes' on intractable London Clay, the most individual feature being the development during the seventeenth century of the 'wells' which added Epsom salts to the language. It is the chapters on natural history which can be expected to interest readers of this journal more. All three single out those organisms most likely to attract the notice of the casual visitor, and the presentation, with illustrations by Norah Willett and Harold Gough scattered about the pages, is certainly attractive. What your demanding reviewer would have liked to find more of is an appreciation of what is special about the Common; the plants and animals drawn could all be seen in many other areas of comparable size. We learned in chapter 4 that Epsom and Ashtead Commons jointly have been a Site of Special Scientific Interest since 1955 but the only clues to their interest are Miss Willett's mention of a few flowering plants less common than the rest and Mr. Dye's feature will prove at length to be the natural development of the Great Pond, first dug by medieval monks, drained in the middle of the last century and re-created in 1975-78; it has already been well colonised by riparian and aquatic life.

R. M. Burton

Butterfly Research in I.T.E. By Marney L. Hall. 28pp. Institute of Terrestrial Ecology, Huntingdon. 1981. £1.50.

Any contribution to our knowledge of the lives of our native butterflies, particularly the rarer ones, can only be welcomed, and this summary of the ecological researches of the Institute of Terrestrial Ecology into this subject is certainly worthwhile reading.

The text opens by introducing the reader to the various different recording schemes, commencing with the now familiar Distribution Mapping Scheme organised through the National Biological Records Centre at Monks Wood, and progresses to the Butterfly Monitoring Scheme, started in 1973, and the Porton Down Survey. The values and drawbacks of each are briefly mentioned and discussed and a combination of these three survey methods, the booklet concludes, will indicate when a species is declining and therefore in need of conservation. Whilst this may be so, I personally find it rather sad that one has to go to such lengths to prove that a species is in need of conservation, and I am sure that the large blue *Maculinea arion*, were it able to speak for itself, would agree with me. However, having reached this conclusion a summary of the results of the Institute's latest ecological researches into seven selected rare species follows, and this section, to my mind, is well worth the otherwise rather high price of the booklet.

On reflection, twenty-eight pages does seem rather little in return for £1.50, but then there are twenty-two colour photographs of a fairly high quality which do help to justify this figure whilst the text is well written, accurate and easy to follow. There is, in fact, very little to fault in this rather attractive publication, apart from one or two minor spelling mistakes as, for example, in the generic name of the large blue, and these in no way detract from the interest and readability of the booklet. It should certainly be given a space on the shelves of anyone seriously interested in the study of British butterflies.

C. W. Plant

The London Naturalist

Instructions to Contributors

Submission of papers

Papers relevant to the natural history and archaeology of the London Area should be submitted to the editor, Mr K. H. Hyatt, Department of Zoology, British Museum (Natural History), Cromwell Road, London SW7 5BD, before the end of January if they are to be considered for publication in the same year. They should be typed, with double spacing and wide (three cm) margins, on one side of the paper. Authors must retain a duplicate copy. Papers should include at the beginning an abstract, summary, or synopsis.

Text

Locality spellings should follow the latest editions of the maps published by the Ordnance Survey. Capitalization should be kept to a minimum. Common names of animals and plants must begin with lower-case initials, and scientific names must be underlined. When both common and Latin names are given there should be no brackets or commas separating them. Genus names should appear in full where first used within each paragraph. When scientific names are taken from a standard work, which must be cited, authorities should be omitted. In descriptive matter numbers under 10 should be in words, except in a strictly numerical context. Dates should follow the logical sequence of day, month, year (i.e. 25 December 1971). Measurements should be in metric and follow the SI system (Système International d'Unités), with imperial equivalents in parentheses where appropriate. There should be no full point following Dr, Mr, Mrs or St. Lists should be in natural, alphabetical or numerical order.

References

Reference citation should be based on the Madison rules (in *Bull. Torrey bot. Club* **22** : 130-132 (1895)), except that a colon should always precede a page number. Capitalization in titles of papers in journals should be kept to a minimum. Journal titles should follow the abbreviations in the *World List of Scientific Periodicals* and be underlined. Examples are as follows:

In text:

Meadows (1970 : 80) or (Meadows 1970).

In references:

MEADOWS, B. S. 1970. Observations on the return of fishes to a polluted tributary of the River Thames 1964-9. *Lond. Nat.* **49** : 76-81.

MELLANBY, K. 1970. *Pesticides and Pollution*. Ed. 2. Collins, London.

WHITE, K. G. 1959. Dimsdale Hall moat, part II. *Trans. a. Rep. N. Staffs. Fld Club* **92** : 39-45.

Illustrations

Distribution maps should be submitted in the form of a Recording Map with symbols in Indian ink or Letraset. Solid dots are used to indicate contemporary or recent presence, circles for old records and crosses (not plusses) for other information, such as introduced species. Tetrad dots and circles should be 4.0 mm and tetrad crosses 5.0 mm, with a line thickness of 0.8 mm; all monad symbols should be 1.6 mm with a line thickness of 0.5 mm. The caption should be written outside the frame of the map and will be set up by the printer. The Mapping Schemes Secretary can provide Recording Maps, advice and dies for printing distribution symbols.

Line drawings should be in Indian ink on white card, larger than the printed size. Place names, etc., must be produced with stencils or Letraset. Captions should be separate as they will be set up by the printer.

Photographs should be glossy black-and-white prints, of good contrast, preferably half-plate in size.

Proofs

Galley proofs will be sent to authors for scrutiny, but only essential corrections can be made at that stage.

Reprints

Up to 25 free reprints will be supplied on request. Additional copies may be purchased if ordered when the proofs are returned.

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